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BIOLOGIA

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The nematode parasites of the birds of Hyderabad (India)

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INTRODUCTION

A comprehensive study of the nematode parasites of Birds of Hyderabad State was done by Dr. S. N. Singh, during 1948-1949. The work was further advanced by Dr. S. M. Ali who described eight new species of avian nematodes. On their suggestion the writer undertook the investigation of nematode infestation of birds. The tropical forests and plateau of Hyderabad are extremely rich in avian fauna which provide an extensive field for research. A collection of the nematodes was made from 1955-1957 and the results of the studies are herewith submitted.

The birds for the investigation were purchased from the local bird market. Majority of the parasites were collected from under the tunic of the gizzard and a few like *Tetrameres* and *Microtetrameres* were recovered from the lumen and glands of the proventriculus. *Geopetitia* had to be detached very carefully from the nodules found on the outer wall of the proventriculus. Species of *Oxyspirura* were all collected either from the orbital cavity or were found crawling over the eyeball. Specimens of *Singhfilaria* were collected from under the skin of the neck and those of *Chandlerella* from the peritonial membrane near the heart. *Paraprocta*, *Eufilaria*, *Buckleyfilaria* and *Lissonema* were obtained from the body cavity. *Hamatospiculum* was seen to fill up the air sacs and was even found in the body cavity attached to the visceral organs.

The spiruroids were preserved in steaming 70 per cent alcohol containing 15 per cent glycerine, but the filariids were directly transferred to the cold glycerine alcohol. Lactophenol and beachwood creosote gave good results for transparency of the worms possessing thick cuticle. Glycerine jelly proved a successful medium for mounting the end-on views.

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PART I

Acuariidae Suerat, 1913.

ACUARIINAE Railliet, Henry and Sisoff, 1912.

Acuaria Bremser, 1811.

The genus *Acuaria* was established by Bremser, 1811, 'without a type species and without naming the included species' (Cram). Rudolphi, 1819, regarded *Spiropstera anthuris* as the type of the genus *Anthuris*, but as *Anthuris* was the renaming or *Acuaria* Bremser, 1811, it became the type species of *Acuaria*. Dujardin, 1845, proposed yet another name *Dispharagus* for the same genus. Later on *Acuaria* was accepted by Railliet, Henry and Sisoff, 1912, as the valid name of the genus and the other names, *i.e. Anthuris*, *Spiroptera* and *Dispharagus* were dropped into synonymy. They also established a new sub-family *Acuariinae* for the reception of *Acuaria*, *Cheilospirura*, *Dispharynx*, *Synhimantus* and *Hamannia*. The latter was synonymised with *Echinuria* in 1912 by Soloviev. The chief distinguishing feature separating one genus from the other except in *Cheilospirura* (which has distinctly unequal spicules) is the form and structure of the cordons.

The genus *Acuaria* has had an intricate history beginning from the type species itself. *A. Anthuris* even today is the most misleading of all the type species. It has been described from ime to time by several authors; each worm, though differing from the other in salient features, is recognised as one and the same. Since then, many species had been added to the genus. Of these, the worms described earlier are poorly accounted for; their descriptions being based on either females or in one case *A. tarentolae*, Seurat, 1916, on a solitary larva. Hence, Cram, 1927, grouped all such worms *i.e.*, *A. quadriloba* (Rud. 1819) Railliet, Henry and Sisoff, 1912, *A. mamillaris* (Molin, 1860) Railliet, Henry and Sisoff 1912, *A. muscicapae* (Linstow, 1878) Railliet, Henry and Sisoff, 1912, *A. ptilopachydis*, Gendre, 1920, and *A. macrolaima* (Linstow, 1906) Railliet, Henry and Sisoff, 1912, as *Acuaria* sensu lato. Railliet, Henry and Sisoff, 1912, besides re-examining the above mentioned species further scrutinized and redescribed *A. attenuata* (Rud. 1819), *A. ornata* (Gendre, 1912), *A. depressa* (Schneider, 1866), *A. gracilis*, (Gendre, 1912). *A. tenuis* (Duj. 1845), *A. subula* (Duj. 1845) and *A. papillifera* (Linst., 1878). The descriptions of these species were based on both male and female worms. Gendre redescribed *A. cordata* (Mueller, 1897) in 1920. In 1926, Ozerska reported *A. skrjabini* from the House Sparrow of Don district, Russia. Cram, 1927, assigned this species to the genus *Cheilospirura* but Williams in 1929, replaced it in *Acuaria*. *A. skrjabini* has moderately unequal

spicules as are possessed by *A. subula* and does not exhibit a marked difference in the length of spicules like other species of *Cheilospirura*. Williams, 1929, reported *A. nebraskensis*, *A. minor*, *A. pattoni*, *A. minuta*, *A. quiscula*, *A. sialia*, *A. lina* and *A. tyranna*, all from American birds. Of these, the males of the last two are unknown. In *A. minor* both the males and the females are known whereas the females of *A. pattoni* and *A. minuta* are unknown. All the three male worms have almost the same body lengths being 4.6 mm., 4.0 mm. and 3.9 mm. respectively. Besides, various body measurements, as shown in the table, are so similar and the differences so slight, that it hardly justifies the creation of two new species for the worms named as *A. pattoni* and *A. minuta*. Hence in the writer's opinion, the species should be regarded as synonyms of *A. minor*.

Name of the worm	Length of the oesophagus in mm.	Length of the cordons in mm.	Length of the caudal alae in mm.	Number of caudal papillae	Spicules
A. minor	1.12	1.4-1.74	0.39	4 preanal 7 postanal	0.156 and 0.152
A. pattoni	1.09	1.2	0.37	4 preanal 6 postanal	0.156 and 0.155
A. minuta	1.17	1.1-1.2	0.43	4 preanal 7 postanal	0.160 and 0.140

The same is the case with *A. quiscula* and *A. sialia*. The female is known in the former and unknown in the latter. The body lengths and various other measurements exhibit such a close similarity that the differences should be regarded merely as individual variations.

Name of the worm	Body length in mm.	Length of Oesophagus in mm.	Cordons in mm.	Caudal papillae	Spicules in mm.
A. quiscula	5.22-10.34	1.51	0.146-0.287	4 preanal 6 postanal	0.109-0.136 0.157-0.186
A. sialia	6.1	1.05	0.263-0.276	4 preanal 6 postanal	0.103 & 0.165 ...

Moreover, the shape of the caudal alae and the disposition of papillae are exactly the same. In view of these close resemblances the writer regards *A. sialia* as a synonym of *A. quiscula*. *A. nebraskensis* is reported from *Corvus brachirhynchus* from which *A. anthuris* has also been described. A close study of the lengths, the proportion of the oesophagus to the body, the

lengths and proportions of the cordons, the presence of subterminal papillae on the female tails and the position of the vulva leads one to the irresistible conclusion that the two worms are one and the same.

All measurements in millimetres

	Body length	Oesophagus	Cordons	Spicules	Pairs of caudal papillae	Vulva
			A. anthuris of Singh 1948			
Male	8.5-11.2	2.36-2.72 *i.e.* 1/3 of body length	3.5-4.2 *i.e.* 1/3 of body length	0.209-0.219 0.251-0.262	4 preanal 7 postanal	
Female	18.9-27.5	4.4-6.2 *i.e.* 1/5 of body length	7.1-7.2 *i.e.* 1/4 of body length			In the vicinity of the equator of the body
			A. nebraskensis, Williams, 1929			
Male	6.71-10.44	2.2-3.2 *i.e.* 1/3 of body length	2.5-3.6 *i.e.* 1/3 of body length	0.271-0.325 0.231-0.282	4 preanal 8 postanal	
Female	17.6-20.31	3.18-3.7 *i.e.* 1/5 of body length	4.5-7.4 *i.e.* 1/4 of body length			In the vicinity of the equator of the body.

Thus *A. minor* (syns. *A. pattoni* and *A. minuta*) and *A. quiscula* (syn. *A. sialia*) are to be accepted as the valid ones. LeRoux, 1930, described *A. martinagliai* from South Africa as a parasite of weaver bird (*Hyphantornis* sp.). Schikobalova, 1930, declared *A. ornata* to be the synonym of *A. anthuris.*

In the year 1931-32, five* more species were added to the genus by Maplestone from India. Of these the males of *A. lata* and *A. indica* are unknown. He also described *A. anthuris* from red-billed Chough (*Graculus eremita*) a new host, other than *Corvus* which Cram regarded as the only host of this species. Earlier Baylis and Daubney (1922) had reported a female worm of this species from yet another host, the red-billed blue magpie (*Urocissa occipitalis*) from India. Baylis, 1939 and Singh, 1948 regarded *A. scutata* as the synonym of *A. anthuris.* In the same year, 1931, Hsu and Hoeppli reported *A. longicaudata* from China. Ortlepp, 1938, recorded

**A. lata, A. indica, A. conica, A. scutata, A. brevispicula.*

A. semei from the giant bustard in South Africa. Johnston and Mawson, 1941, contributed three more species *A. corvicola* of which the female alone is described, *A.* (*cheilospirura*) *streperina* and *A. flindersi*. There seems to be some confusion in the assignment of the last two species to the respective genera. *A.* (*cheilospirura*) *strep rina* is stated to have 'spicules unequal, 0.1 mm. and 0.26 mm. long, similar in shape' the other species *A. flindersi* has 'long spicule 0.51 mm. in length, tubular proximally, narrowed distally; short spicule 0.18 mm. long, spatulate with blunt tip.' The discrepancy is evident. Probably the description of one is attributed to the other. As such the writer is obliged to regard '*Streperina*' as a species of *Acuaria* and '*flindersi*' as of *cheilospirura*. In 1945, Lent, Freitas, Teixeira and Proenca reported *A. mayori* in *Syanocorax chrysops* from Paraguay. Singh, 1948, redescribed *A. anthuris* in both the common house crow and the jungle crow in India and added a new species *A. kungi* to the genus. Sarwar, 1956, while reporting *Acuaria anthuris* and *A. brevispicula* from Pakistan, regards *A. kungi* Singh, 1948, as a synonym of *A. brevispicula* Maplestone, 1932. But in having a body length almost twice as long as that of Maplestone's worm, in the number of caudal papillae (12 pairs against 9), in the shape of the caudal alae and in the length of the cordons, *A. kungi* differs so much from *A. brevispicula* that the two can hardly be regarded as synonyms. Thus there are altogether 30 species of the genus described so far. Out of these, only those species are included in the key of which the males are known. All the species grouped under 'Sensu lato' by Cram are omitted. Worms which are regarded as synonyms are also eliminated.

A. anthuris (Rudolphi, 1819) Railliet, Henry and Sisoff, 1912

(Syn. *A. scutata* Maplestone, 1931 and *A. ornata* Gendre, 1912)

The following account of *A. anthuris* is based on a single male specimen once collected from *Sturnia malabarica malabarica*. The worm occurred under the horny layer of the gizzard.

It is a fairly stout worm measuring 9.16 mm. in length and 0.23 mm. in maximum width. The body is of uniform diameter attenuated only for a short distance near the head and tail ends. The cuticle bears transverse striations which are set at intervals of 10μ. The bluntly conical lips are prominent each one bearing a pair of cephalic papillae and a laterally placed amphid. The ventrodorsal diameter of the head is 55μ. The cordons are well-developed arising in pairs between the bases of the lips in dorsoventral position and running backwardly up to 1/3rd of the body length measuring 3.4 mm. on the left and 4.6 mm. on the right. The pseudocordons are

present all along the length of the body on the mid-dorsoventral surfaces. The excretory pore opens at 0.41 mm. from the head end. The nerve ring is seen a little behind the junction of the Pharynx with the muscular portion of the oesophagus measuring 0.31 mm. from the anterior end. The cervical papillae are situated at 0.35 mm. from the tip of the head. The Pharynx measures 0.23 mm. and the total length of the oesophagus is 2.13 mm. The muscular and glandular portions of the oesophagus being 0.55 mm. and 1.58 mm. long respectively.

There is a pair of well-developed caudal alae 0.89 mm. long by 0.34 mm. wide supported by 11 pairs of caudal papillae of which 4 pairs are preanal and the rest postanals. The postanals are arranged in two groups of 3 pairs each and a solitary pair at the tip of the tail. The tail is 0.37 mm. long and ends in a rounded tip. The alae extend beyond the tail end. The spicules are sub-equal measuring 0.25 and 0.28 mm. in length. They are stout thickly chitinized with alate expansions starting just below the head and running all along their bodies.

This species has been recorded from several hosts in Europe and Asia. In India, it was reported from the Red-billed Blue Magpie, *Urocissa erythrorhynca occipitalis* by Baylis and Daubney (1922) and from the red-billed chough, *Graculus eremita* by Maplestone (1931). Singh, 1948, recorded it from the common house crow, *Corvus splendens* and the jungle crow *C. macrorhynchu*. It is now being reported from a new host, the grey-headed Myna *Sturnia malabarica*.

Host : *Sturnia malabarica*
Habitat : Under the horny layer of gizzard
Locality : Hyderabad-Deccan (India).

Acuaria brevispicula Maplestone 1932.

A male and a female specimens of this species were once collected from the gizzard of the common Myna, *Acridotheres tristis tristis*. As the description of the species was based on the male only, it is thought advisable to redescribe it.

The body is slender in both the sexes with a uniform diameter tapering only at the ends. The cuticle bears fine striations set at intervals of 9μ in the middle of the body. The conical lateral lips are prominent and bear a pair of submedian and a single lateral papillae (amphid). The head is 0.03 mm. and 0.05 mm. in the dorsoventral diameter in the male and female respectively. The cordons arise in pairs on the dorsoventral surfaces of the

head from where they curve outwards and backwards to pursue a posterior course. In addition to these the 'pseudocordons' are also present in the lateral fields. They are faintly developed in the region of the pharynx but further backwards they gradually become more and more prominent. The cervical papillae are small and situated at 0.20 mm. from the head end in the male and 0.25 mm. in female. The excretory pore opens at 0.26 mm. and 0.32 mm. from the anterior end in the male and the female respectively. The nerve ring surrounds the oesophagus just behind the junction of pharynx and the muscular portion and is 0.16 mm. from the head end in the male and 0.20 mm. in the female.

MALE : The male is small and almost one-third the length of the female, measuring 4.57 mm. in length and 0.16 mm. in maximum thickness. The cordons occupy 1/4th of the body length, being 1.05 mm, long. The pharynx is 0.13 mm. long and the two portions of the oesophagus measure 0.26 and 0.73 mm. respectively. The total length occupying 1/4th of the body length. The caudal alae, 0.40 mm. long and 0.18 mm. wide are longitudinally divided into an inner and an outer area. The posterior region is marked off by a constriction, thus dividing the caudal alae into a narrow posterior and a broader anterior portion. The posterior portion being 1/4th of the anterior. There are 9 pairs of caudal papillae arranged in three groups of 3 pairs each. The first group being preanal and the rest postanals. The caudal papillae are costiform and equidistant in each group. The first pair of papillae of the first postanal group is 0.02 mm. from the cloaca and the second postanal group is situated near the tip of the tail being 0.03 mm. apart from the last papillae of the first postanal group. The spicules are similar and equal being 0.115 mm. and 0.118 mm. in length. They are stout and highly chitinised except at their head ends. The cloacal aperture is 0.18 mm. from the tip of the tail.

FEMALE : The female measures 11.57 mm. in length and 0.32 mm. in maximum thickness. The lips are bluntly conical and the cordons arising from their posterior margins terminate just before the end of the oesophagus measuring 1.918 mm. in length and occupying 1/6th part of the body. The pharynx is 0.18 mm. long and the two muscular and glandular portions of the oesophagus are 0.48 mm. and 1.56 mm. long respectively. It occupies 1/5th of the entire body length. The vulva which is flush with the body surface is almost equatorial and placed at a distance of 5.83 mm. from the anterior end. The vagina is muscular and the thick shelled embryonated eggs are 33μ long by 24μ wide. The tail is bluntly pointed and 0.24 mm. in length.

Host : *Acridotheres tristis tristis*
Habitat : Gizzard
Locality : Hyderabad-Deccan (India).

Acuaria alii sp. nov.

On one occasion two specimens of this species, one male and one female, were collected from under the horny layer of the gizzard of the Bank Myna (*Acridotheres ginginianus*).

The sexes differ in size, the female being four times as long as the male and the latter markedly thinner than the former. The cuticle is finely striated and the transverse striations ar 3μ apart in the male and 10μ in the female. The lateral lips are conical and fairly prominent. The cordons arising in pairs on either side of the lips are comparatively faintly developed in both the sexes and terminate just before the end of the glandular portion of the oesophagus at 1.02 mm. and 2.04 mm. in the male and female respectively, covering almost 1/4th and 1/6th of the body length in the two sexes. 'Pseudocordons' are absent. The head is 0.025 and 0.03 mm. in maximum diameter in the male and the female respectively, and bears two pairs of cephalic papillae and a pair of amphids. The cervical papillae are minute, situated at 0.18 mm. from the head end in the male and 0.20 mm. in the female. The excretory pore is seen at 0.24 mm. and 0.26 mm. from the anterior end in the two sexes respectively. The nerve ring surrounds the muscular portion of the oesophagus near its commencement at 0.15 mm. from the head in the male and 0.17 mm. in the female. The pharynx is a narrow tube with striated walls and is 0.13 mm. long in male and 0.21 mm. in the female. The anterior muscular and the posterior glandular portions of the oesophagus are 0.37 mm. and 0.95 mm. long in the male and 0.64 mm. and 1.72 mm. in the female. The total length of the oesophagus is 1.32 mm. and 2.36 mm. in the male and the female occupying 1/3rd and 1/6th of the body length in the two respective sexes.

MALE : The male measures 3.95 mm. in length by 0.13 mm. in maximum width. The caudal alae are well-developed and are 0.34 mm. long by 0.14 mm. wide. There are altogether nine pairs of costiform papillae of which two pairs are preanal, one adanal and the rest postanal in position. The postanal papillae of the right side do not correspond in symmetry with their counterparts on the left. The last pair consists of very minute papillae situated near the tip of the tail. The spicules are short, stout and dissimilar measuring 0.11 mm. and 0.10 mm. The right spicule is broad and possesses an inwardly curved tip with an orbicular expansion at its end. The left

spicule has a rounded but notched tip. The cloacal aperture is 158μ from the tip of the tail.

Female : The female is much stouter than the male and measures 13.05 mm. in length and 0.37 mm. in maximum diameter. The vulva is equatorial, flush with the surface of the body and is 6.14 mm. from the tip of the tail. The muscular vagina is directed backwards from the vulva along the ventral surface of the body cavity. The thick shelled embryonated eggs measure 36-38μ long by 23-25μ wide. The tail is short and bluntly rounded at the tip. It is 0.24 mm. long occupying 1/54th of the body length.

Discussion. In possessing fewer pairs of caudal papillae and having cordons less than half the length of the body this species shows affinities with *A. brevispicula* Maplestone, 1932 and *A. depressa* (Schneider, 1866) Railliet, Henry and Sissoff, 1912. It can, however, be differentiated from the above mentioned species in possessing two pairs of preanal papillae whereas *A. brevispicula* has three and *A. depressa* four pairs. *A. alii* can be further distinguished from the related species in the shape of the spicule which possesses an inwardly curved process with an orbicular expansion. In addition to these, the present worm differs from others in the principal body measurements. It is, therefore, concluded that the worm described above forms a new species of the genus *Acuaria*. It is proposed to name it *A. alii* after Dr. S. Mehdi Ali, Reader in Zoology, Osmania University.

A. upupa n. sp.

The writer once collected two males and two females of this species from the Indian Hoopoe, *Upupa epops orientalis*, the worms were lying under the horny layer of the gizzard.

These are long worms with cylindrical bodies, slightly tapering at their ends. The female is considerably larger than the male, being about three times as long as the latter. The males measure 11.65-12.1 mm. in length and 0.14-0.15 mm. in maximum diameter and the females 32.2-35 mm. and 0.2-0.23 mm. respectively. The mouth is surrounded by two prominent bluntly conical, lateral lips, each of which bears a pair of cephalic papillae and an amphid. The cordons are short but well-developed arising in pairs on either side of the lips extending posteriorly along the submedian lines, they measure 0.34-0.35 mm. in the male and 0.41-0.42 mm. in the female constituting 1/33rd and 1/77th of the entire body length in the two sexes respectively. No pseudocordons are to be seen. The cuticular striations are 4μ and 8μ apart in the male and the female respectively. The excretory pore is situated at 0.26-0.28 mm. in the male and 0.38-0.42 mm. in the female. The cervical

papillae are in the lateral fields between the cordons at 0.22-0.23 mm. and 0.27-0.31 mm. from the head end in the two sexes respectively. The nerve ring surrounds the muscular portion of the oesophagus near its anterior end and is 0.20-0.22 mm. from the anterior extremity in the male and 0.23-0.25 mm. in the female. The mouth leads into a cylindrical pharnyx which has striated walls measuring 0.17-0.19 mm. in the male and 0.26-0.29 mm. in the female. The oesophagus is 1.80-1.84 mm. long in the male and 1.85-1.99 mm. in the female occupying 1/6th and 1/18th of the body length in the two sexes respectively. The muscular and the glandular portions of the oesophagus measure 0.42-0.44 mm. and 1.38-1.4 mm. in the male, 0.45-0.56 mm. and 1.40-1.43 mm. in the female.

MALE : The tail is provided with wide caudal alae which are divided longitudinally into two portions and measure 0.42-0.49 mm. in length and 0.24-0.28 mm. in maximum width. There are eleven pairs of caudal papillae of which four are preanal, one adanal and six postanal in position. The postanals fall into three natural groups of two pairs each. The spicules are almost straight and equal. The right spicule is notched at its tip in the shape of 'M'. The tip of the left spicule is obliquely pointed. The two measure 0.162-0.176 mm. and 0.168-0.185 mm. in length. The cloacal aperture is situated at 220-250μ from the tip of the tail, oc upying 1/48th of the body length.

FEMALE: The female is a fairly thick and long worm. The vulva is almost equatorial and situated on a slight prominence of the body wall, 15.54-17.8 mm. from the tip of the tail. The eggs are thick and embryonated, measuring 32-37μ by 22-24μ. The short and pointed tail is 0.27-0.28 mm. long, constituting 1/125th of the total body length.

Discussion. Takin into account the body length and the number of caudal papillae, this species resembles *A. anthuris*, Railliet, Henry and Sisoff, 1912 and *A. cordata* (Mueller, 1897) Gendre, 1920. It can however, be differentiated from them in the following features :

(1) In possessing very short cordons it comes closer to *A. cordata*, but the latter has twelve pairs of caudal papillae whereas the former possesses eleven. The disposition of the caudal papillae also differs in the two species. In *A. cordata* there is one adanal, one solitary pair of papillae in the mid postanal region and the rest six pairs are aggregated near the tip of the tail, but in the worm under discussion the postanals are in three groups of two pairs each. The shape of the caudal alae contributes another very well marked point of difference. In *A. upupa* the alae are uniformly narrowed towards the tip whereas in *A. cordata* they can conveniently be divided into

three regions. The spicules of *A. cordata* are unequal, but equal in the present worm.

2. As against the short cordons of *A. upupa*, the cordons of *A. anthuris* are very long. Ths spicules are alate in *A. anthuris* but non-alate in the present species. The female tail of *A. upupa* is devoid of the pair of papillae present in *A. anthuris*.

It also resembles *A. kungi* in having similar spicules but the latter has subequal spicules (0.119 and 0 122 mm.) whereas the present worm has equal spicules (0.16 mm.). It also differs in possessing six postanal caudal papillae as against seven pairs of *A. kungi*. Moreover the male of the former is much longer than that of the latter and the female of *A. kungi* is half as long as that of *A. upupa*.

As result of these differences, the writer feels justified in determining a new species for the worm recorded from *Upupa epops orientalis*. It is proposed to name it *A. upupa*.

Host : *Upupa epops orientalis.*
Habitat : Gizzard.
Locality : Hyderabad Deccan (India).

A. singhi n. sp.

One single male was collected from the gizzard of *Temenuchus pagodarum*.

This is a medium sized worm with cylindrical body attenuated at both the ends. The mouth lies between the two lateral bluntly conical lips each of which bears a pair of cephalic papillae near its base and a laterally situated amphid. The cuticle which is rather thick bears fine transverse striations set at intervals of 4μ. There are four cordons fairly well-developed each consisting of a double row of cuticular prominences of varying shapes and sizes. The cordons gradually become less pronounced and finally disappear a little distance in front of the posterior end of the oesophagus.

The worm measures 5.06 mm. in length and 0.12 mm. in maximum thickness. The dorsoventral diameter of the head is 0.02 mm. The cordons measure 1.09 mm. in length and occupy 1/5th part of the entire body. The excretory pore is seen at 0.26 mm. from the head end. There are minute cervical papillae situated at a distance of 0.22 mm. from the head end. The nerve ring surrounds the anterior end of the muscular portion of the oesophagus and is 0.16 mm. from the anterior end. The pharynx is 0.14 mm.

long. It is followed by the oesophagus which is divided into muscular and glandular portions and has a total length of 1.17 mm., occupying $^1/_5$th part of the entire body. The two anterior and posterior portions are 0.30 and 0.87 mm. respectively.

The tail is straight and has a rounded tip. The caudal alae measuring 0.34 mm. long by 0.13 mm. wide, are supported by eight pairs of pedunculated papillae of which two pairs are preanal. The postanals are arranged in two groups of three pairs each. The spicules are short, stout and unequal 110μ and 85μ. The left attains its maximum thickness in the middle and has a notch at the tip and a broad anterior end. The right spicule has an expanded anterior end, a straight body and somewhat obliquely truncated tip. The cloacal aperture is 0.15 mm. from the tip of the tail.

Discussion. The species exhibits close affinities with *A. alii* in having two pairs of preanal papillae, but it differs from it in a number of salient features. In *A. alii*, there are seven pairs of postanals whereas in the present worm the number is six. The arrangement of the caudal papillae is asymmetrical in the former, but symmetrical in the latter. In the worm under discussion, the right spicule is devoid of the inwardly curved tip. Moreover, they are unequal, thinner and shorter than those of *A. alii*. Though the present worm is larger in the body length than *A alii*, the proportion of the oesophagus to the body is $^1/_5$th in former and $^1/_3$rd in latter. The structure of the cordons also differs considerably in the two worms. Hence the present worm is regarded as a new species and is named as *A. singhi* after Dr. S. N. Singh, Professor of Zoology, Osmania University.

Host : *Temenuchus pagodarum.*
Habitat : Gizzard.
Locality : Hyderabad-Deccan (India).

A. dicrura n. sp.

The following description of a new species is based on the material collected on one occasion from the white bellied Drongo *Dicrurus caerulescens caerulescens*.

The sexes differ markedly in the size of the body but have a uniform diameter slightly tapering at the ends. The head diameter is 0.023 mm. in the male and 0.039 mm. in the female, in its maximum thickness and bears a pair of conical lips with a pair of cephalic papillae at their bases. An amphid is also present laterally between each pair of cephalic papillae The cuticle is fairly thick and bears fine transverse striations. The striae are 2μ apart in

the male and 5μ in the female in the middle of the body. The cordons are very short and faintly developed occupying 1/33rd and 1/65th of the body length ending in the anterior third of the muscular portion of the oesophagus in the male and female respectively. The cordons consist of a double row of cuticular prominences set close together. They extend upto a distance of 0.17 mm. in the male and 0.45 mm. in the female. The excretory pore opens at 0.17 mm. and 0.37 mm. from the head end in the two sexes respectively. The nerve ring surrounds the muscular portion of the oesophagus a little behind its commencement. The cervical papillae are seen almost in the level of the nerve ring at 0.13 mm. from the anterior end in the male and 0.29 mm. in the female. The mouth opens into the pharynx which has striated walls and a length of 0.12 mm. and 0.22 mm. in the two sexes respectively. This is followed by the muscular and glandular portions of the oesophagus measuring 0.47 mm. and 0.99 mm. in the male and 0.79 and 2.16 mm. in the female. The two portions together measure 1.46 mm. and 2.95 mm. constituting 1/4th and 1/10th part of the entire body.

MALE: It is a very slender worm of a medium sized body measuring 5.87 mm. The posterior extremity is supported by well-developed caudal alae which are 0.33 mm. long. They are divided into two portions, a broader anterior and a narrower posterior region. The maximum width of the anterior portion is 0.19 mm. There are altogether ten pairs of caudal papillae of which four are preanal and the rest postanals. The first of the postanal pairs is symmetrical but the second pair is asymmetrically situated. The rest of the four pairs form a group near the tip of the tail. The spicules are subequal and measure 0.143 and 0.123 mm. in length. They are similar in shape except the fact that the left spicule has a notched tip and the right a spatulate end. The cloacal aperture lies at a distance of 0.19 mm. from the tip of the tail.

FEMALE : The female is a fairly long worm almost five times the length of the male, measuring up to 29 mm. The vulva is in the posterior part of the body situated at 9.1 mm. from the tip of the tail. Vagina has muscular walls and measures up to 0.54 mm. in length. The tail is short and rounded at its end, the anus lying at 0.26 mm. from its tip. The embryonated eggs measure 33μ by 22μ.

Discussion. This species seems to resemble *A. quiscula* Williams, 1929, *A. gracillis* Railliet, Henry and Sisoff, 1912, *A minor* Williams, 1929, and *A. conica* Maplestone, 1931, in having a medium sized body length, short cordons and in the number of caudal papillae. The present worm differs from them in the disposition of its caudal papillae. In *A. dicrura*, there are

two isolated postanal pairs of which one is asymmetrical and the other group of four pairs near the tip of the tail, whereas all the above-mentioned species have postanals in two groups of three pairs each. In *A. quiscula* the caudal alae are not divided into two regions as they are in *A. dicrura.* Moreover the vulva is anterior to the middle of the body in the former whereas it is posterior, and quite close to the anus in the latter. *A. dicrura* has shorter cordons (1/33rd of the total body length) but in *A. gracilis* they occupy 1/28th of the total body length. It also differs from *A. gracilis* in having non-alate spicules. Same is the case with *A. minor* and *A. conica* which can be easily distinguished from this species in the length of the cordons and the structure and shape of the spicules. *A. minor* has much longer cordons running up to 1/3rd part of the body and possesses equal spicules. *A. conica* and *A dicrura* can be separated from each other by the presence of one alate and one non-alate spicule in the former and the absence of alae on the spicules of the latter.

In view of the above facts of differences the worm described here is regarded to be a new species. It is proposed to name it *A. dicrura.*

Host : *Dicrura coerulescens coerulescens.*
Habitat : Gizzard.
Locality : Hyderabad-Deccan (India).

A. crami n. sp.

One male and a badly damaged female worm of this species were once recovered from the gizzard of Indian stone-chat *Saxicola caprata caprata.*

The male is a rather small worm with a body of uniform diameter slightly attenuated towards the anterior and posterior ends. It measures 4.44 mm. in length and has a maximum thickness of 0.121 mm. The cuticle bears fine transverse striations which are separated by intervals of 3-4μ in the middle of the body. The cordons are four in number and arise in pairs between the two lateral lips. They run posteriorly in the submedian zone of the body wall measuring 1.04 mm. in length, occupying 1/4th part of the body and ending a little distance ahead of the posterior end of the oesophagus. There are two conical lateral lips, each bearing two submedian papillae and an amphid. The mouth opens into a 0.16 mm. long narrow pharynx with thick striated walls. The oesophagus which follows, occupies almost 1/4th of the total length of the body and measures 1.26 mm. Its muscular and glandular portions being 0.28 mm. and 0.98 mm. long respectively. The nerve ring surrounds the oesophagus near its anterior end at a distance of 0.18 mm. from the tip of the head. The cervical papillae are located just adjacent to the excretory pore which measures 0.20 mm. from the anterior extremity.

There is a single testis extending almost to the region of the oesophagus where it recurves and runs backwards entering the last 1/3rd portion of the body, to terminate in a posteriorly directed knobbed tip. The tail tapers sharply and is flexed ventrally bearing fairly developed caudal alae, 0.42 mm. long. The caudal alae are distinctly divided into a short, narrow almost rectangular posterior part and a long, broad evenly expanded anterior portion. The maximum width of the caudal alae is 0.10 mm. The cloacal aperture is 0.185 mm. from the tip of the tail. There are altogether twelve pairs of caudal papillae of which five pairs are preanal and the rest postanals. The first two pairs of the preanals being somewhat asymmetrical. Besides the four pairs of pedunculated preanal papillae there is a pair of sessile papillae on the mid ventral surface just in front of the cloaca. The postanal papillae form two groups of three and four pairs each. The second group of postanal papillae is located inside the posterior narrow portion of the caudal alae. The first pair is asymmetrical, the next two pairs are symmetrical while the fourth and the last pair is rather small. situated just near the tip of the tail. The spicules are short, stout and highly chitinized. They are subequal measuring 0.129 and 0.101 mm., the left being the longer. Both the spicules have expanded heads. The left spicule has a slight depression near its posterior tip while the right is distinctly notched.

Discussion. Taking into account the number of caudal papillae, this species resembles *A. anthuris* Railliet, Henry and Sisoff, 1912. *A cordata* Gendre, 1920, *A. martinagliai* Roux, 1930 and *A. kungi* Singh, 1948, all possessing 12 pairs. However, the present worm differs from all of them in possessing a midventral precloacal pair of caudal papillae. In having five pairs of preanal papillae this species comes closer to *A. martinagliai*, but the latter is twice as long as the former. The adanal papillae which are present in *A. martinagliai* are absent in *A. crami*. The latter possesses seven pairs of postanals arranged in two groups of three and four pairs each but in *A. martinagliai* they are almost evenly distributed. The shape of the caudal alae also differs in the two.

A. anthuris, *A. cordata* and *A. kungi* are almost twice as long as the present worm and possess four preanals only.

A. papillifera, while agreeing in body length possesses four preanals and eight postanals. Moreover, the arrangement of the postanals also differs in the two species.

A. tenuis Railliet, Henry and Sisoff, 1912, is reported from the same host, *Saxicola* sp. The present worm agrees with it in body length but differs from it in the length of the spicules, shape of the caudal alae and also

in having twelve pairs of prominent papillae as against the 'slightly salient' papillae of *A. tenuis*. Other body measurements also differs in the two worms.

As a result of the differences exhibited, the writer concludes that it belongs to a new species. It is proposed to name it *A. crami* n. sp.

Host : *Saxicola caprata caprata.*
Habitat : Gizzard.
Locality : Hyderabad, Deccan (India).

Key to the species of the genus *Acuaria* Bremser, 1811

Caudal alae absent, vulva near the anus.	*A. semei* Ortlepp, 1938
Caudel alae present, vulva not close to the anus,	1
1. Females 18 mm. long.	2
Femles more or less than 18 mm. long.	4
2. Males 7 mm. long, eggs 15μ (?) long.	*A. attenuata* (Rud., 1819) Railliet, Henry and Sisoff, 1912.
Males 4.8 mm. long, eggs more than 30μ long.	3
3. Oesophagus 1 mm. long, spicules 0.14 and 0.095 mm.	*A. tenuis* (Duj., 1845) Railliet, Henry and Sisoff, 1912.
Oesophagus 2 mm. long, spicules 0.19 and 0.12 mm.	*A. subula* (Duj., 1845) Railliet, Henry and Sisoff, 1912.
4. Caudal papillae less than 10 pairs,	5
Caudal pappillae 10 or more than 10 pairs.	8
5. 2 pairs of preanals.	6
3 pairs of preanals, 6 pairs of postanals in 2 groups of 3 each.	*A. brevispicula* Maplestone, 1932.
4 pairs of preanals and 5 pairs of postanals.	7
6. Spicules equal (115μ and 104μ) Right spicule with an orbicular inwardly curved tip, 7 pairs of postanal papillae ; oesophagus 1/3rd of the body length (in male).	*A. alii* n. sp.
Spicules unequal (110μ and 85μ) Right spicule without a curved tip, 6 pairs of postanal papillae, oesophagus (1/5th of the body length in male).	*A. singhi* n. sp.
7. Spicules almost equal ; female 22. mm. long.	*A. depressa* (Schneider, 1866) Railliet, Henry and Sisoff, 1912.

Spicules unequal (0.10 mm. and 0.26 mm.)... females 13-15.		*A. streperina* Johnston and Mawson, 1941.
8. 10 pairs of caudal papillae	...	9
More than 10 pairs of caudal papillae	...	14
9. Spicules 0.2 or more than 0.2 mm. long	...	*A. longicaudata*, Hsu and Hoeppli, 1931.
Spicules less than 0.2 mm. long	...	10
10. Cordons longer, 1/3rd of the body length	...	*A. minor* Williams, 1929.
Cordons shorter, 1/20th of the body or shorter		11
11. Spicules non-alate	...	12
Spicules alate (one or both)	...	13
12. Postanal papillae in 2 groups of 3 pairs each, vulva anterior to the middle of the body	...	*A. quiscula* Williams, 1929.
Postanals in 2 groups of 2 and 4 each Vulva posterior to the middle of the body.		*A. dicrura* n. sp.
13. One spicule alate; vulva in the posterior half of the body.		*A. conica* Maplestone, 1931.
Both the spicules alate, vulva equatorial.	...	*A. gracilis*, (Gendre, 1912), Railliet, Henry and Sisoff, 1912.
14. 5 pairs of preanal papillae.	...	15
4 pairs of preanal papillae.	...	16
15. Male 4.4 mm. long, midventral preanal papillae present, adanals absent.		*A. crami* n. sp.
Male 8.3 mm. long, midventral preanal papillae absent, adanals present.		*A. martinagliai* Roux, 1930.
16. Cordons 1/3rd of the body length	...	*A. anthuris* (Rud. 1819) Railliet, Henry and Sisoff, 1912.
Cordons very short.	...	17
17. Spicules unequal.	...	18
Spicules subequal or equal.	...	21
18. 8 pairs of postanal papillae.	...	19
Less than 8 pairs of postanal papillae.	...	20
19. Males 10-11 mm. long.	...	*A. cordata* (Mueller, 1897) Gendre, 1920.
Males 4,7 mm. long.	...	*A. papillifera* (Linstow, 1878) Railliet, Henry and Sisoff, 1912.

20. Spicules alate, males 4.6-5.9 mm. females 10.3-19 mm.	*A. mayori* Lent, Freitas, Teixeira and Proenca, 1945.
Spicules non-alate, males 8.7-9.2 mm., females 23-27 mm.	*A. skrjabini*, Ozerska, 1926.
21. Male 8.25 mm., female 15.7 mm. Spicules subequal (0.119 and 0.122), 7 pairs of postanal papillae.	*A. kungi* Singh, 1948.
Males 11.6-12.6 mm., females 32-35. Spicules equal (0.16 mm.), 6 pairs of postanal papillae.	*A. upupa* n. sp.

Acuariidae Seurat, 1913.

ACUARIINAE Railliet, Henry and Sisoff, 1912.

Dispharynx Railliet, Henry and Sisoff, 1912.

In 1819, Rudolphi described a spirurid worm as *Spiropteranasuta*. In subsequent years almost a dozen worms were reported by various writers from various places, under several names, all of them being synonyms of the above-mentioned worm. It has been named as *Dispharagus*, *Cheilospirura* and lastly as *Acuaria*. In 1912, Railliet, Henry and Sisoff divided the genus *Acuaria* into six subgenera, one of them being *Dispharynx* for Rudolph's *Spiroptera nasuta*. Skrjabin, 1916, raised these sub-genera to generic rank.

In 1920, Stiles and Hassall redescribed *D. nasuta* in greater detail. Meanwhile another worm *Dispharagus spiralis* was recorded by Molin in 1858. This was regarded for a long time as the type species of the genus. Later on, it was confirmed that the latter is a synonym of *Dispharynx nasuta*. The latter having been described earlier than *D. spiralis*, is regarded as the type species of the genus *Dispharynx*. Harwood, 1933, reported *D. stonae* which also later on fell synonym to *D. nasuta*.

At present there are altogether 14 species of the genus described from various parts of the world all from avian hosts, namely, *D. nasuta* (Rud. 1819) Stiles and Hassall, 1920, *D. noctuae* (Seurat, 1913) Stiles and Hassall, 1920, *D. laplantei* Seurat, 1919, *D. magnilabiata* (Molin, 1860) Gendre 1920, *D. capitata* (Molin 1860) Cram, 1927, *D. crassissima* (Molin 1860) Cram, 1927, *D. rectovaginata* (Molin, 1860) Cram, 1927, *D. smitiana* (renaming of *D. notoi* Smit, 1927) Strand, 1929, *D. fieldingi* Baylis, 1934, *D. emberizae* Yamaguti, 1935, *D. pipilonis* Olsen, 1939, *D. pelecani* Johnston and Mawson, 1942, *D. pavonis* Sanwal, 1951 and *D. brevicordon* Schuurmans Stekhoven

Jr., 1952. The material studied by the writer consists of 4 species of *Dispharynx*, two of which are contributed as new. Tiner, 1951, reported *D. sorici* for the first time from a mammalian host, *Sorex obscurus*, but Oche in 1955, erected a new genus for it.

The following characteristics are taken into account while preparing the key to the species of *Dispharynx* :—

(*i*) The straight or wavy nature of the cordons.
(*ii*) The position of the cervical papillae.
(*iii*) The presence or absence of the sessile papillae at the tip of the male tail.
(*iv*) The number and orientation of the caudal papillae.
(*v*) The spicules, their shape and length ratio.
(*vi*) The presence or absence of papillae at the tip of the female tail.

D. crassissima of which the male is unknown is not included in the key. Although the male of *D. capitata* is reported by Yamaguti, 1935, from a different host, *Otus bakhamoena semitorques*, it is also excluded due to its uncertain specific diagnosis.

Dispharynx nazuta (Rudolphi, 1819) Stiles and Hassall, 1920.

(Syn. *Dispharynx spiralis* Molin, 1858 ; Skrjabin, 1916).

Eight males and nine females of this species were once collected from the proventriculus of *Athene brama indica*, the northern spotted owlet. This species has been recorded from many countries in quite a few hosts. As it has already been described by Baylis, 1939 and others, only a brief account of the worm is given below. The species is now being recorded from a new host the northern spotted owlet (*Athene brama indica*).

MALE : 4.89-5.39 mm. long by 0.21-0.25 mm. wide ; lips small and conical ; cordons wavy extending up to 0.42-0.53 mm. from the head end. The bicuspid cervical papillae and excretory pore are situated a little distance in front of the posterior limits of the cordons. Nerve ring 0.126 mm. from the anterior end. Pharynx 0.102-0.13; muscular portion of the oesophagus about 0.49-0.59 mm. and the glandular portion about 1.27-1.56 mm., caudal end spirally coiled, ventral surface tessellated, caudal alae long and narrow, 1.17-1.24 mm. long by 0.3-0.4 mm. wide. Caudal papillae pedunculated, four pairs preanal and five pairs postanal. Second and third pairs of postanal asymmetrical. Spicules 0.124 and 0.441 mm. long. Tail 0.25-0.33 mm. long.

FEMALE : 2.85-5.25 mm. long by 0.31-0.37 mm. in maximum width.

Cervical papillae 0.37-0.40 mm. from the head end. Nerve ring and excretory pore 0.115-0.127 mm. and 0.39-0.40 mm. from the anterior end. Cordons 0.44-0.47 mm. in length, pharynx 0.08-0.14 mm. long; anterior oesophagus 0.65-0.68 mm. and posterior oesophagus 1.4-1.8 mm. long. Vulva 1.3-1.5 mm. from the tip of the tail. Tail 0.097-0.139 mm. long with a median ventral papilla. Eggs 40μ by 22μ embryonated.

Host : *Athene brama indica.*

Habitat : Proventriculus and oesophagus.

Locality : Hyderabad-Deccan (India).

Dispharynx pavonis Sanwal, 1951

The writer once collected a male and three females of *D. pavonis* from the proventriculus of the jungle babbler, *Turdoides terricolor.* This worm is reported from the *pavo cristatus* in India. The writer here records it from a new host. The body measurements are as follows :—

MALE : 5.75 mm. long by 0.26 mm. wide; cordons wavy, 0.42 mm. long, cervical papillae 0.34 mm. from the anterior extremity. The nerve ring and the excretory pore are 0.14 mm. and 0.30 mm. from the head end respectively. Pharynx 0.088 mm.; oesophagus 2.18 mm. long, muscular and glandular portions 0.43 mm. and 1.75 mm. respectively. Caudal alae 1.37 mm. in length, eight pairs of pedunculated papillae, four pairs preanal and four pairs postanal. 3 pairs of sessile papillae and a solitary papilla at the tip of the tail ; postanals asymmetrical in position ; spicules 0.42 and 0.12 mm. Tail 0.32 mm. long.

FEMALE : 3.9-6.43 mm. long by 0.22-0.40 mm. wide; cordons 437-635μ in length ; nerve ring 0.22-0.27 mm. from the head end. Bicuspid cervical papillae and the excretory pore 0.33-0.42 mm. and 0.28-0.30 mm. respectively. Pharynx 0.10-0.12 mm.; oesophagus 2.3-2.6 mm.; the anterior portion 0.62-0.7 mm., posterior 1.76-1.97 mm. long. Vulva 0.81-1.0 mm. from the tip of the tail. Eggs 47μ by 22μ, embryonated. Tail 0.11-0.12 mm. long with a single papilla at its tip.

The asymmetrical arrangement of the postanal papillae is regarded as an individual variation. The small pedunculated papillae and a single sessile papilla are seen only under higher magnification.

Host : *Turdoides terricolor.*

Habitat : Proventriculus.

Locality : Hyderabad-Deccan (India).

Dispharynx skrjabini n. sp.

The material available for study consists of many worms both males and females obtained from the stomach of the pallas' fishing eagle, *Haliaeetus leucoryphus*. The worms were found with their heads deeply embedded in the mucosa of the stomach and had to be detached carefully.

The two sexes do not show any marked difference in their lengths. They have a medium sized slender body with tapering extremities. The cuticle is thick and transversely striated. The striae are at intervals of 7μ in the male and 9μ in the female. The cordons are straight and run up to a distance of 0.608-0.732 mm. and 0.78-0.82 mm. from the anterior end in the male and the female respectively. The cordons end immediately after curving. The ends point towards the lateral fields rather than anterior. In the females, however, the cordons recurve and have limbs measuring up to 0.117 mm. in length. The head is somewhat rounded and bears a pair of papillae and an amphid on each lip. The dorsoventral diameter of the head ranges from 0.048-0.055 mm. in the male and 0.074-0.076 mm. in the female. The cervical papillae which are in the form of simple laterally pointed stumpy projections are situated at 0.54-0.59 mm. from the head end in the male and 0.62-0.662 mm. in the female. The excretory pore opens at a distance of 0.29-0.33 mm. from the tip of the head in the male and 0.38-0.40 mm. in the female. The nerve ring surrounds the oesophagus at about 0.18-0.19 mm. and 0.21-0.23 mm. in the male and female respectively.

The mouth leads into the pharynx, 0.138-0.158 mm. long in the male and 0.17-0.19 mm. in the female. The wall of the pharynx is thickly striated. The oesophagus is divided into an anterior muscular and a glandular posterior portion measuring 0.33-0.48 mm. and 1.75-1.78 mm. long in the male, 0.49-0.52 and 2.3-2.5 mm. in the female respectively. The entire oesophagus is 2.08-2.20 mm. and 2.098-3.02 mm. in the male and female respectively and occupies 1/3rd of the total body length in both the sexes.

MALE : The males measure 5.92-6.45 mm. in length by 0.24-0.26 mm. in maximum thickness. The posterior end is spirally coiled with the conical tail measuring 0.19-0.22 mm. in length. The caudal alae are prominent surrounding the tip of the tail being 1.44-1.58 mm. in length and 0.19-0.28 mm. in breadth. These are supported by nine pairs of caudal papillae of which four are preanal and five postanal in position. In addition to these there are five sessile papillae near the tip of the tail. Four of the sessile papillae are arranged symmetrically in two pairs, the fifth is mid-ventral in position. All these are visible in the ventral view and under a high

magnification. Rest of the caudal papillae are very peculiar being club-shaped or pedunculate, the two alternating each other. The distance between the first two preanals is fairly marked while the third and fourth pairs are situated close together. The first pair of postanal papillae are like the second group of preanals while the third and the fourth postanals resemble the first preanal group. The last postanal pair is rather isolated being situated near the tip of the tail on either side of the group of sessile papillae.

The two spicules are unequal in length and dissimilar in shape. The left and the right spicules measure 0.54-0.58 mm. and 0.181-0.185 mm. in length respectively. The left being three times as long as the right. The left spicule is slightly chitinized and possesses a backwardly pointed barb at its tip. The right spicule is stout, thickly chitinized with a broad expanded head and a somewhat curved tip.

FEMALE : The females hardly differ in size from that of males measuring 7.25-7.46 mm. in length by 0.36-0.38 mm. in maximum width. The tail is very short, broadly rounded, possessing a solitary papilla at its tip and is 0.074-0.076 mm. long. The vulva is in the posterior region near the anus, 0.371 mm. from the tip of the tail. The vagina is short and muscular. The eggs are thick-shelled containing coiled embryos and measure 0.035-0.038 mm. in length by 0.024-0.024 mm. in maximum diameter.

Discussion. The worm bears close resemblance with *D. magnilabiata* (Molin, 1860) Gendre, 1920 and *D. noctuae* (Seurat, 1913) Stiles and Hassall, 1920, in possessing straight cordons. It, however, differs from both of them in having cordons which end immediately after curving (male), or in having a very short recurrent limb (female). In this particular respect it resembles *D. brevicordon* Schuurmans Stekhoven (Jr.) 1952, but the cordons of the present worm are straight as against the wavy cordons of the latter. Moreover, *D. brevicordon* seems to possess 5 pairs of preanal papillae while *D. skrjabini* has only 4 pairs. The former also lacks the group of sessile papillae quite prominently present on the male tail end of the latter.

The female of *D. magnilabiata* is almost twice as long as that of the present worm. The tail end of the male in *D. magnilabiata* is devoid of the group of sessile papillae observed in the species under discussion. Besides these differences, there are five pairs of postanal papillae in *D. skrjabini* and seven pairs in *D. magnilabiata.*

D. noctuae differs from the present species in possessing cervical papillae posterior to cordons, smaller spicules and the left lacking the barbed

tip mentioned above. The vulval opening is just behind the middle of the body in the former whereas it is distinctly posterior, quite close to the anus in the latter.

It also resembles *D. r ctovaginata* (Molin, 1860) Cram, 1927 and *D. pipilonis* Olsen, 1939, in having alternately pedunculate or club-shaped caudal papillae but it differs from both of them in possessing five pairs of pedunculated papillae instead of four pairs. Moreover, the cordons are straight in the present worm while they are wavy in *D. rectovaginata* and *D. pipilonis*. The shape of the spicules also differs in two.

Thus the writer regards this worm as a new species, *D. skrjabini*.

Host : *Haliaeetus leucoryphus*

Habitat : Stomach

Locality: Hyderabad-Deccan (India).

Dispharynx indicus n. sp.

In December 1955, a solitary male of this species was obtained from the proventriculus of the Indian Barn owl *Tyto alba stertens*.

This is rather a medium-sized worm measuring 9.86 mm. in length and 0.26 mm. in maximum thickness. The body is of a uniform diameter with the head not markedly conical as is usual with the other species of the genus. The posterior end tapers into an acute tail. The cuticle is thick with transverse striations set 8μ apart. The lips are fairly prominent each possessing a pair of submedian cephalic papillae and a laterally situated amphid. The cordons are almost straight and originate in pairs between the bases of the lips and extend backwards for a distance of 0.4 mm., then curve anteriorly, the recurrent limbs measuring 0.26 mm. The cervical papillae are tricuspid, fairly prominent, situated at a distance of 0.57 mm. from the head end or 0.17 mm. behind the posterior end of the cordons. The excretory pore is 0.46 mm. from the anterior end. At about 0.18 mm. from the head, the oesophagus is surrounded by the nerve ring, a little distance behind the origin of its anterior portion. The mouth opens into a cylindrical pharynx which has thick and muscular walls measuring about 0.22 mm. in length. The oesophagus occupies 1/3rd of the entire body length and measures 3.95 mm. It is divided into a narrow anterior region measuring 0.78 mm. and a comparatively broader posterior glandular portion 3.25 mm. long. The cloaca opens at a distance of 0.34 mm. from the posterior end.

The single testis extends anteriorly up to the distal end of the glandular oesophagus. The posterior end of the worm is spirally coiled and possesses

well-developed caudal alae measuring 1.20 mm. in length and 0.4 mm. in the maximum width. There are altogether nine pairs of pedunculated papillae and a group of five sessile papillae at the tip of the tail. The left spicule is slender and measures about 0.60 mm. in length. The right one has a broader head and a blunt tip and is 0.19 mm. long. The lengths of the two spicules are almost in the ratio of 4 : 1.

Discussion: This species shows closer affinities with *D. magnilabiata* (Molin, 1860) Gendre 1920, *D. noctuae* (Seurat, 1913) Stiles and Hassall 1920 and *D. skrjabini* described in this paper, in possessing straight cordons. In having cervical papillae situated posterior to the cordons, it also agrees with *D. pelecani* Johnston and Mawson 1942. It differs from each of the above-mentioned species in the following features:

D. magnilabiata has seven postanal papillae while there are only five pedunculated pairs in the present worm with five sessile papilae at the tip of the tail which are lacking in the former. The fourth, fifth and sixth pairs of papillae are close together in *D. magnilabiata*, but they are evenly distributed in *D. indicus*.

Though the number of postanal pedunculate papillae in *D. noctuae* is the same as in this worm, the former is devoid of the group of the sessile papillae at the tip of male tail.

The length ratio of the two spicules in *D. noctuae* is 2 : 1 whereas it is 3.5 : 1 in the present worm. The left spicule of *D. indicus* is more than twice as long as that of *D. noctuae* and the right spicule of the former is one and a half times the length of the latter.

D. skrjabini differs from the present worm in having alternately short pedunculated or long club-shaped papillae. The left spicule of *D. skrjabini* has a barb at its tip which is lacking in *D. indicus*. The shape of the right spicule also differs markedly in the two worms. The caudal alae of *D. skrjabini* are long and narrow but comparatively shorter and broader in *D. indicus*.

D. pelecani has wavy cordons and the lateral alae extend from the region of 'cervical papillae to past mid length of the body.' Both these characters are lacking in *D. indicus*. The spicules of the former are distinctly smaller than those of the latter. The body lengths of the two worms also differ markedly, *D. pelecani* being half as long as *D. indicus*.

D. indicus also differs from all these above-mentioned worms in possessing a different structure of the cordons (comb-shape) which is quite

peculiar to the species of this genus, a character in which it resembles *Synhimantus*.

As a result of these differences, the writer feels justified in establishing a new species for the worm recorded from the owl *Tyto alba* in Hyderabad. It is proposed to name it *D. indicus*.

Host : *Tyto alba stertens*
Habitat : Proventriculus
Locality: Hyderabad-Deccan (India).

Key to the species of the genus Dispharynx.

Cordons wavy	...	1
Cordons straight	...	9
1. 5 pairs of preanal papillae	...	*D. brevicordon* Stekhoven, 1952.
4 pairs of preanal papillae	...	2
2. Tip of the male tail with sessile papillae	...	3
Tip of the male tail without sessile papillae	...	6
3. 5 pairs of pedunculated postanal papillae and a pair of sub-median sessile papillae 4 pairs of pedunculated postanal papillae	...	*D. fieldingi* Baylis, 1934. 4
4. 3 pairs of sessile papillae, cordons slightly wavy	...	*D. pavonis* Sanwal, 1951.
One pair of sessile papillae, cordons sinuous		5
5. Pedunculated papillae similar anterior half of the right spicule without a terminal hook		*D. emberizae*, Yamaguti, 1935.
Pedunculated papillae dissimilar anterior half of the right spicule with a terminal hook	...	*D. pipilonis* Olsen, 1939.
6. 4 pairs of postanal papillae	...	*D. rectovaginata* (Molin, 1860) Cram, 1927.
5 pairs of postanal papillae	...	7
7. Lateral alae present, tip of the left spicule with a hook		*D. pelecani* Johnston and Mawson, 1942.
Lateral alae absent, left spicule acicular	...	8
8. Spicule ratio 1:4 (L. S. 0.865 mm. R. S. 0.240 mm.), vulva in the posterior third of the body	...	*D. laplantei* Seurat, 1919.

	Spicule ratio 1:3 vulva near the middle of the body	*D. nasuta* (Rudolphi 1819) Stiles and Hassall, 1920.
9.	Tip of the male tail without sessile papillae ...	10
	Tip of the male tail with sessile papillae ...	11
10.	Male 6.5 mm.; female 10.11 mm. 5 pairs of postanal papillae	*D. noctuae* (Seurat, 1913) Stiles and Hassal, 1920.
	Male 7.5 mm., female 13.16 mm. 7 pairs of postanal papillae	*D. magnilabiata* (Molin 1860) Gendre, 1920.
11.	Caudal alae narrow 0.19-0.28 mm. caudal papillae alternately pedunculated or club-shaped L. S. with a hooked tip ...	*D. skrjabini* n. sp.
	Caudal alae broad 0.4 mm., pedunculated caudal papillae of uniform type; L. S. without a hooked tip ...	*D. indicus* n. sp.

Acuariidae Seurat, 1913*a*

ACUARIINAE Railliet, Henry and Sisoff, 1912

Rusguniella Seurat, 1919*a*

Rusguniella alii n. sp.

Four males and five females of this species were collected from under the horny layer of the Indian Pied Kingfisher, *Ceryle radis leucomelanura* in Hyderabad-Deccan.

The worms are long and filiform, whitish in colour with slightly attenuated extremities. The dorsoventral diameter of the head is 24-27 μ in the male and 27-29 μ in the female, bearing two prominent conically pointed lips each having a pair of submedian papillae and a laterally situated amphid. The head is surrounded by lateral membranous expansions measuring 0.075-0.087 mm. in length and 0.048-0.054 mm. in maximum width. The cordons originate in pairs from the bases of the lips and run in the lateral fields for a short distance, then curve back towards the apex so that a triangular loop is formed.

The cuticle is thin, detached from the body in the cephalic region, where its axial portion forms an annular collar round the head and the periphery expands and protrudes to form a prepuce-like sheath which under slight pressure is reverted to form lappets at the base of the head. The cervical papillae are located at a distance of 0.11 mm. from the head end in both the sexes. A little behind this is the nerve ring surrounding the anterior part of the muscular oesophagus at 0.133-0.138 mm. from the anterior end

in the male and 0.139-0.140 mm. in the female. The excretory pore opens at about 0.174-0.178 mm. and 0.188-0.197 mm. from the tip of the head in the two sexes respectively.

The mouth is followed by a cylindrical thick-walled pharynx, 0.124-0.126 mm. long in the male and 0.127-0.128 mm. in the female. The muscular portion of the oesophagus measures 0.43-0.477 mm. and 0.499-0.517 mm. in the male and the female respectively. The glandular portion measuring 2.06-2.15 mm. in the male and 2.3^{6}-2.56 mm. in the female. The entire oesophagus occupies 1/5th and 1/8th of the total body length in the two sexes respectively.

MALE : The male is half size of the female measuring 10.60-10.66 mm. in length and 0.083-0.097 mm. in the maximum diameter. The posterior end is flexed ventrally, surrounded by the caudal alae. 0.538-0.725 mm. long by 0.167-0.176 mm. wide. There are nine pairs of caudal papillae of which three are preanal and the rest postanal. The preanals are closely set. The first pair of postanals is isolated from the group of the next three postanals which lie at a distance of 52 μ from the first. The last pair of postanals lies near the tip of the tail. Midway between the last pair of the postanals and the fourth pair lies the fifth. The spicules are very unequal and dissimilar, the left being four times as long as the right. The latter is navicular, broad and thickly chitinized measuring 0.215-0.224 mm. by 48-52μ. The left spicule is comparatively thin and less chitinized with an acicular tip. It is 0.916-0.988 mm. long. The cloacal aperture lies at 0.23-0.257 mm. from the tail end.

FEMALE : The females are very long worms almost double the size of the males. They are 20-25 mm. long by 0.138-0.152 mm. wide. The vulva opens at 0.962-1.25 mm. from the tip of the tail. A thick muscular vagina which is 0.62 mm. long, is posteriorly directed. The two uteri run backwards for a short distance and take a turn to adopt a forward course. The uterus is tightly packed with embryonated eggs, 30-33μ long by 19-22μ wide. The tail is very short with a pair of small papillae at the tip, the anus opening at 0.091-0.099 mm. from the distal end.

Discussion: Seurat in 1919, established the genus *Rusguniella* for *Spiroptera elongata* Rudolphi, 1819 and also transferred *Spiroptera vanelli* to the new genus. Since then only three more species are added to the genus. Maplestone, 1931, described the first Indian species *R. brevis* from *Ceryle alcyon*, the Kingfisher. In the same year Wehr erected a new genus *Aviculariella* for the worm from American Kingfisher. But Baylis, 1939 regarded the genus as synonymous with *Rusguniella*. Ssolonitzin in 1932

reported *R. transcaucasica* from *Larus cochinnas*. In 1937, Williams added another species *R. kofoidi* from the Lesser Scaup Duck *Nyroca affinis*, the description being based only on the larval forms. The males of *R. elongata* and *R. vanelli* are unknown.

The present worm differs both from *R. brevis* and *R. transcaucasica* in several respects. Both the males and the females of *R. brevis* are half or more than half as long as the present worm. The spicules of the worm under discussion have almost double the length of those of *R. brevis*. The latter has two pairs of preanals and five pairs of postanal papillae. Moreover, the cephalic cuticular inflations which are so prominent in *R. alii* are absent in *R. brevis*. *R. transcaucasica* possesses four pairs of postanal papillae and is devoid of the cephalic cuticular expansions. In *R. transcaucasica* the vulva is almost equatorial whereas it is situated near the anus in *R. alii*. In this particular feature the latter also differs from *R. elongata* in which the vulva is pre-equatorial. The female of *R. alii* is almost four to five times as long as that of *R. vanelli*.

Taking into consideration the various differences exhibited by this worm, it is regarded as new species, naming it after Dr. S. M. Ali, Reader in Zoology, Osmania University, Hyderabad-Deccan.

Host : *Ceryle radis leucomelanura*

Habitat : Gizzard

Locality: Hyderabad-Deccan (India)

Key to the species of Rusguniella.

Cuticular expansions present	...	1
Cuticular expansions absent	...	3
1. Vulva in the anterior region of the body; female 24.40 mm. long. Male unknown	...	*R. elongata* (Rudolphi, 1819), Seurat, 1919.
Vulva in the posterior region of the body	...	2
2. Cuticular expansions in the cervical region. 2 pairs of preanal and 5 pairs of postanal papillae, Spicules 0.14 mm. and 0.5 mm.		*R. brevis*, Maplestone, 1931.
Cuticular expansions in the cephalic region; 3 pairs of preanal and 6 pairs of postanal papillae; spicules 0.21-0.22 mm. and 0.91-0.98 mm.	...	*R. alii* n. sp.
3. Females 4.6 mm. long	...	*R. vanelli* (Rudolphi, 1819), Seurat 1919.
Females 18 mm. long	...	*R. transcaucasica* Ssolonitzin, 1932.

Ancyracanthidae Railliet, 1916

SCHISTOROPHINAE Travassos, 1918

Torquatella Yorke and Maplestone, 1926

Torquatella singhi n. sp.

On one occasion the writer collected a male and a female of this species from the Black Drongo, *Dicrurus macrocercus*, the worms harboured under the horny layer of the gizzard.

These are filiform worms with cylindrical bodies slightly tapering at their extremities. The cuticle is thin and bears fine transverse striations set at intervals of 4μ at the middle of the body in the male and 6μ in the female.

The male is 2.9 mm. long by 0.047 mm. in maximum diameter and the females 7.52 mm. by 0.059 mm. respectively. The cervical papillae are laterally situated and are found projecting from the body wall at 0.129 mm. and 0.136 mm. from the anterior end in the male and the female respectively. The excretory pore is at 0.111 mm. from the tip of the head in the male and 0.129 mm. in the female. At a distance of 0.099 mm. from the head end in the male and 0 115 mm. in the female the anterior muscular portion of the oesophagus is surrounded by the nerve ring. The head bears two lips, behind which are arranged cuticular prominences in two rows, there being six prominences in the anterior and eight in the posterior row. Each lip possesses two pairs of submedian cephalic papillae arranged in two circles with laterally situated amphid seen in the outer circle. The mouth opens into a short, narrow chitinized pharynx measuring 24μ in the male and 33μ in the female. The two portions of the oesophagus are 0.15 mm. and 0.45 mm. long in the male and 0.16 mm. and 0.60 mm. in the female. The entire oesophagus measures 0.60 mm. forming 1/5th of the body length in the male and 0.70 mm. occupying 1/10th of the entire body in the female.

Male : The male is almost half as long as the female. The posterior end is flexed ventrally. The caudal alae are well-developed and are marked with transverse striations along their entire length. The two alae are symmetrical and are 0.213 mm. long. The caudal papillae are constiform and somewhat asymmetrical in arrangement. Altogether 13 pairs of caudal papillae are present of which ten are preanal in position and three postanal. The spicules are unequal and acicular in shape, the right and left measure 0.107 mm. and 0.077 mm. in length respectively. The gubernaculum is strongly chitinized 7μ long and 8μ wide. The cloaca is at 0.080 mm. from the tip of the tail.

FEMALE : The tail is bluntly pointed and 0.102 mm. long. The vulva is flush with the body situated at 2.9 mm. from the tail end. The muscular vagina is 1.64 mm. long. The uterine limbs are opposed. The anterior ovary is seen lying, in the first quarter of the body and the posterior ovary extends as far as the vicinity of the cloaca. The oval eggs measure 28μ long and 19μ broad and are embryonated at the time of disposition.

Discussion: The known species of the genus are; *T. torquata* (Gendre, 1922), *T. balanocephala* (Gendre, 1922), *T. conocephala* (Molin, 1860), Yorke and Maplestone, 1926, *T. crotophaga*, Williams, 1929, and *T. longiovata* Ali 1956. The present worm differs from all in being the smallest in length, and in possessing the least number *i.e.* 13 pairs of caudal papillae as against 21 pairs in *T. conocephala*, 20 in *T. crotophaga.* and 17 in *T. longiovata.* The spicules are also the smallest of the other three species.

It is therefore concluded that the parasite described above constitutes a new species. It is proposed to name it *Torquatella singhi* after Dr. S. N. Singh, Professor of Zoology, Osmania University, Hyderabad-Deccan.

Host : *Dicrurus macrocercus*

Habitat : Gizzard

Locality: Hyderabad-Deccan (India)

Type specimens of the species described in this part are deposited in the Zoology Department, Osmania University, Hyderabad-Deccan (India).

SUMMARY

1. Five new species of *Acuaria* are described and a key to the species of the genus is provided. *A. anthuris* is reported from a new host and *A. brevispicula* is described in detail.

2. Two new species of the genus *Dispharynx* are recorded and two more species are reported from new hosts. A key to the species of the genus is given.

3. An account of a new species of *Rusguniella* is given with the key to the known species of the genus.

4. A new species of *Torquatella* is recorded from *Dicrurus macrocercus.*

5. All the genera and the species are revised.

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PART II

Thelaziidae : Railliet, 1916*a*.

Oxyspirura **:** Drasche in Stossich, 1897.

In 1860, Molin described three worms as *Spiroptera cephaloptera, S. momoti brasiliensis* and *S. orioli.* Diesing, 1861, renamed the first species as *Cheilospirura cephaloptera.* In 1897, Drasche in Stossich established a new genus *Oxyspirura* for the reception of all the above-mentioned species with *O. cephaloptera* as its genotype.

In the same year (1897), Stossich transferred four other species described by Molin to *Oxyspirura*, these being *O. anacanthura, O. brevisubulata, O. sygmoidea* and (?) *O. brevipenis.* Later in 1904, Ransom redescribed *O. mansoni* (Cobbold 1879), *O. ophthalmica* (Linstow, 1903) (?), *O. heteroclita* (Molin, 1860) and *O. siamensis* (Linstow, 1903). In 1910, Sweet recovered a worm from *Gallus gallus* and regarded it as a new species, *O. parvovum*, but Baylis in 1934, declared it to be the synonym of *O. mansoni.* Johnston, in 1912, described *O. anthochaerae* from Australia, the description being based on a dried up and ill preserved specimen. *O. tanasijtchuki* was reported in 1916 from South America by Skrjabin. In 1927, Walton gave an account of *O. americana*, the description of which is based only on the female. In 1929, Skrjabin contributed *O. petrowi, O. schulzi, O. popowi, O. baskakowi* and *O. podjapolskoi*, and in 1931 divided the genus *Oxyspirura* into three subgenera, *Oxyspirura, Cramispirura* and *Yorkeispirura.* He separated the latter from the first two on the basis of its buccal capsule, which is divided into a broader anterior and a narrower posterior portion. The subgenus *Oxyspirura* is distinguished by the possession of unequal spicules as against equal spicules of *Cramispirura.* Sandground, 1930, added *O. elani* to the genus from Liberia in Africa. Khalil, 1932, reported another African species *O. crami* from Liberia. In 1933, Hsu, H. F., added three more Chinese species, *O. kaitingensis, O. peipingensis* and *O. tsingchengensis* to the genus. *O. myzomelae* was described by Baylis in 1935 from Solomon Islands. In the same year, Bear recovered *O. conjunctivalis* from lemur, the first species of the genus to be recorded from a mammalian host. In each of the subsequent three years Caballero contributed a new species *i.e. O. navali* (1936), *O. toroi* (1937) and *O. crassa* (1938). In 1937, Caballero while classifying his Mexican species placed *O. navali* under subgenus *Cramispirura* but in the description of the species in 1936, he had stated, 'las

espiculas son desiguales.' He has given the lengths of the two spicules as 0.22 mm. and 0.42 mm. a character which is contrary to *Cramispirura*. Moreover, the stoma is shown as being divided into two portions, a broader anterior and a narrower posterior one. Hence the species is now assigned to *Yorkeispirura*. Stekhoven, 1937, reported *O. wittei* from Brazil. *O. streperae* and *O. bancrofti* were described by Johnston and Mowson in 1941, from Australia. In 1942, Caballero contributed his fourth species, *O. (Y.) octopapillata* Singh, 1948, while redescribing *O. (C.) popowi* and *O. (Y.) mansoni* added two more new species, *O. (O.) buccosulcata* and *O. (O.) indica* to the genus *Oxyspirura* from India. Caballero, 1951, added another species *O. (O.) cochlearispiculata*. Caballero's species so closely resembles *O. (O.) peipingensis* in the body length, in the number of precloacal and postcloacal papillae and in the length ratio of the spicules that in writer's opinion *O. (O.) cochlearispiculata* should be regarded as a synonym of *O. (O.) peipingensis* Hsu, 1933.

	Name of the species		Body length in mm.	Oesophagus in mm.	No. of caudal papillae in male	Spicules	Distance of vulva from the tip of the tail in mm.
O. (O.) peipingensis	Male	...	7.2-9.7	0.7-0.9	3 pre-cloacal 3 post-cloacal	0.408-0.510 and 0.180-0.225 i.e. 2.2 : 1	0.57-0.62
	Female	...	12.9	0.97-0.98			
O. (O.) cochlearispiculata	Male	...	8.4-9.1	0.67-0.73	3 pre-cloacal 3 post-cloacal	0.536-0.551 and 0.228-0.255 i.e. 2.1 : 1 2.4 : 1	0.239-0.531
	Female	...	11.27-11.7	0.684-0.840			

In April 1957, Yeh Liang-Sheng contributed the latest species *O. hispanica* from Spain. In his opinion the division of the genus *Oxyspirura* into three subgenera on the basis of the shape of the buccal capsule is unsuitable, but the writer regards Skrjabin's subdivisions as valid because each subgenus possesses more than two or three species, thereby establishing the characteristics of subgeneric importance.

Thus there are altogether 35 species of *Oxyspirura* reported so far. The following account of five species of which four are new, is based on the material collected by the writer in Hyderabad-Deccan, India.

The following important features are taken into account while preparing the present key:

1. The presence or absence of cephalic, cervical or lateral alae.
2. Alate and non-alate character of the spicules.
3. Presence or absence of gubernaculum.
4. Number and arrangement of the caudal papillae.

O. wittei Schuurmans Stekhoven, 1937 and *O. americana* Walton, 1927, of which the males are unknown, are not included in the key. *O. heteroclita* (Molin, 1860) Ranson, 1904, *O. brevipenis* (Molin 1860) Stossich, 1897, are also omitted owing to their generic position being doubtful. *O. podjapolskoi*, Skrjabin, 1929 of which fragments of female alone are known, is also excluded from the key. *O. anthochaerae* (Johnston, 1912) Johnston, 1912, the description of which is very unsatisfactory if redescribed properly from the same host will make *O.* (*O.*) *kaitingensis* Hsu, 1933 its synonym. *O. bancrofti* Johnston and Mawson, 1941 is also excluded from the key as its description is based only on immature forms. Unfortunately the writer could not get Sandground's paper on *O. elani* Sandground, 1930, hence its absence from the key.

Oxyspirura* (*O.*) *peipingensis Hsu, 1933.

Four males and five females of this species were obtained from the orbital cavity of the common babbler *Argya caudata caudata*.

The worms are yellowish white in the living condition. The body is of uniform diameter narrowing towards both the extremities. While the head end is rounded and somewhat truncated, the tail ends in a sharply pointed tip. The cuticle is thin and non-striated. There are present on the head two pairs of prominent and two pairs of smaller submedian papillae and a pair of amphids, in addition to these there are three pairs of small circumoral papillae. The males and the females measure 7.8-9.8 mm. and 11.08-12.6 mm. long by 0.25-0.27 mm. and 0.31-0.39 mm. wide respectively. The cephalic expansions are not present. The excretory pore opens at 0.28-0.29 mm. from the head end in the male and 0.32-0.34 mm. in the female. The nerve ring is located at 0.14-0.16 mm. and 0.19-0.21 mm. from the anterior end in the two sexes respectively. The buccal capsule is 0.027-0.028 mm. by 0.024-0.025 mm. in the male and 0.033-0.034 mm. by 0.025-0.026 mm. in the female. The oesophagus occupies 1/20th and 1/23rd of the entire body length in the two sexes ; being 0.36-0.41 mm. long in

the male and 0.48-0.53 mm. in the female. The two portions are slightly distinct from one another and measure 0.11-0.17 mm. and 0.25-0.34 mm. in length in the male, 0.14-0.17 mm. and 0.34-0.36 mm. in the female.

MALE : The male is smaller in size than the female and has a sharply attenuated tail ; the opening of the cloaca being at 0.16-0.20 mm. from the tip. The testis lies in the middle of the body extending a little distance behind the posterior end of the oesophagus, where it recurves to end in a posteriorly directed tip. The caudal alae are absent. There are six pairs of caudal papillae of which three are precloacal in position and the rest post-cloacal. The last postcloacal pair is situated midway between the cloacal aperture and the tip of the tail. The spicules measure 0.441-0.497 mm. and 0.202-0.231 mm. in length. The left is narrow, longer and tubular, the right stout and thickly chitinized, broad and navicular in shape with a somewhat inwardly curved rounded tip.

FEMALE : The female is almost one and a half times as long as the male. The tail is short and bluntly pointed, measuring 0.20 mm. in length. The vulva is flush with the body and is situated at 0.48-0.52 mm. from the tip of the tail. The muscular vagina is 0.25 mm. long and is directed anteriorly. The uteri run towards the anterior end and on entering the oesophageal region, take a backward course to join the ovaries. The uteri are fully packed with eggs in various stages of development. They are elliptical measuring 24μ long by 7μ in maximum width.

The species is here recorded for the first time from India from a new host.

Host : *Argya caudata caudata.*
Habitat : Orbital cavity.
Locality : Hyderabad-Deccan (India).

Oxyspirura (O.) singhai n. sp.

This species was once recovered from the orbital cavity of the Indian pipit, *Anthus richardi rufulus*. The material consists of a male and a female, which were found crawling over the eye-ball.

The body is slender with a rounded head and a sharply-pointed tail in both the sexes. The male is smaller in size, almost half the length of the female. The cuticle is thin and devoid of transverse striations. The large mouth has a chitinous rim at its apex and is surrounded by six cuticular lobules, bearing four pairs of submedian, two lateral and six small circumoral papillae. The head is surrounded by membranous alae which gradually diminish in breadth and end a little distance behind the excretory pore. The latter opens at 0.305 mm. from the head end in the male and 0.36 mm. in the

female. The nerve ring encircles the oesophagus at a distance of 0.179 mm. and 0.198 mm. from the anterior end in the male and the female respectively. The buccal capsule is surrounded by chitinous walls. It is almost as long as wide, being 24μ by 22μ in the male and 27μ by 24μ in the female. The oesophagus is 0.646 mm. and 0.789 mm. in the male and the female respectively. The two portions measure 0.147 mm. and 0.499 mm. in the male, 0.152 mm. and 0.63 mm. in the female. The entire oesophagus constitutes $^1/_{10}$th and $^1/_{13}$th of the total body length in the two respective sexes.

MALE : The male is 6.48 mm. in length and 0.22 mm. in maximum diameter. The tail which is strongly flexed ventrally does not possess caudal alae. The cloacal aperture is 0.25 mm. from the tip of the tail. The single filiform testis runs anteriorly up to the middle of the body where it recurves and after running for a short distance, ends in a short posteriorly directed tip. There are three pairs of precloacal and two pairs of postcloacal papillae. A pair of phasmids is seen at 0.113 mm. from the tail end. The spicules are 0.28 mm. and 0.12 mm. long. The shorter or the right has a somewhat curved tip and possesses a transparent wing like lateral expansion. The left spicule is twice as long as the right, more slender and is devoid of ala.

FEMALE : The female is 11.87 mm. long with a maximum diameter of 0.437 mm. The anal opening lies at 0.27 mm. from the tip of the tail. The vulva is 0.14 mm. anterior to it or 0.41 mm. from the tail end. The muscular vagina is 0.240 mm. long and is directed anteriorly. The two limbs of the uterus run parallel and are tightly packed with thick shelled embryonated eggs measuring 36μ by 27μ.

Discussion: The species bears resemblance to *O.* (*O.*) *brevisubulata* (Molin, 1860) Stossich, 1897 and *O.* (*O.*) *buccosulcata* Singh, 1948 in possessing cephalic cuticular expansions and in having spicules with a length ratio of 2 : 1 but differs from both of them in the following aspects :

The male as well as the female *O.* (*O.*) *brevisubulata* are twice as long as the present worm. There are 4 pairs of precloacal and 8 pairs of postcloacal caudal papillae in the former whereas the latter possesses only 3 pairs of precloacal and 2 pairs of postcloacals. The spicules of *O.* (*O.*) *brevisubulata* are devoid of alae but the right spicule of the worm under discussion has a distinct ala on its body.

O. (*O.*) *buccosulcata* has a somewhat similar body length as the present worm but it possesses 4 pairs of procloacal and 3 pairs of postcloacal papillae. The right spicule of the former is also devoid of the alate expansion, found in the latter. Moreover, the cuticular expansions start a little distance behind the head end in *O.* (*O.*) *buccosulcata* but here they surround the head end.

It also resembles *O.* (*O.*) *cephaloptera* (Molin, 1860) Stossich, 1897, *O.* (*O.*) *anacanthura* (Molin, 1860) Stossich, 1897 and *O.* (*O.*) *kaitingensis* Hsu, 1933 in the possession of membranous expansions round the head, but it differs from them in the body length, in the ratio of the spicule lengths, the number of caudal papillae and in having an ala on the right (shorter) spicule and not on the left.

In view of the distinguishing characters exhibited by this worm, the writer feels justified in establishing a new species for its reception. It is proposed to name it *O.* (*O.*) *singhi* after Professor S. N. Singh, Head, Department of Zoology, Osmania University.

Host : *Anthus richardi rufulus.*
Habitat : Orbital cavity
Locality : Hyderabad-Deccan (India).

Oxyspirura* (*O.*) *hyderabadensis n. sp.

Three specimens of this species were once collected from the orbital cavity of the black Drongo, *Dicrurus macrocercus macrocercus* commonly known as King Crow in India.

The worms when fresh appear yellowish white in colour. There is little difference in the size of the two sexes. The body is sharply attenuated towards the posterior end in both the sexes. The head is broad with rounded sides and truncated end. The cuticle lacks transverse striations but is marked with fine longitudinal striae. The cephalic expansions are present in both the sexes. While they are narrow running up to 0.31 mm. in the male, they are broader in the female and continued along the entire length of the body. The cervical papillae could not be observed even under an oil immersion lens. The nerve ring and the excretory pore are located at 0.15 mm. and 0.24 mm. from the anterior end in the male and 0.18 mm. and 0.26 mm. in the female respectively. The vestibule is 27μ long by 16μ wide in both the sexes. The muscular and the glandular parts of the oesophagus are 0.093 and 0.36 mm. long in the male and 0.10 and 0.36 mm. in the female. The two portions together form $^1/_{10}$th part of the body in both the sexes.

Male : The male is 4.27 mm. long and 0.235 mm. wide. The caudal end is strongly curved ventrally and is devoid of alae. The sharply pointed tail is 0.127 mm. long. There are altogether eight caudal papillae of which three are precloacal and five postcloacal. The first four postcloacals form a group. The fifth is situated midway between this group and the tip of the tail. The spicules are unequal 0.29 mm. and 0.137 mm. long, thickly chitinized and stout. The left has a broad head but a pointed tip

whereas the right is short, sole-shaped with a broad head and flat tip. Both of them are devoid of the alate expansions.

FEMALE : The female is almost the size of the male being 4.6 mm. in length and 0.23 mm. in width. The vulva is seen near the anal aperture ; the two measuring 0.41 mm. and 0.24 mm. respectively, from the tip of the tail. The vagina has muscular wall measuring 0.26 mm. in length and the two uteri run anteriorly. The oval eggs are 32μ long by 23μ wide.

Discussion : The species under discussion bears affinities with *O.* (*O.*) *brevisubulata*, *O.* (*O.*) *buccosulcata* and *O.* (*O.*) *singhi* described in this paper, in possessing cephalic cuticular expansions and a ratio of 2 : 1 in the lengths of the two spicules. It, however, differs from each of them in several respects. The male of *O.* (*O.*) *brevisubulata* is almost four times and the female five times as long as the present worm. There are 4 pairs of precloacals and 8 pairs of postcloacal papillae in the former but 3 pairs of precloacals and 5 pairs of postcloacals in the latter. *O.* (*O.*) *buccosulcata* is almost double in length of the worm under discussion and has 4 precloacal and 3 postcloacal pairs of caudal papillae.

O. (*O.*) *hyderabadensis* differs from *O.* (*O.*) *singhi* in having 5 pairs of postcloacal caudal papillae as against 2 pairs. Moreover, it has non-alate, thickly chitinized broader spicules. In various other body measurements also the two differ markedly.

Host : *Dicrurus macrocercus macrocercus.*
Habitat : Orbital cavity.
Locality : Hyderabad-Deccan (India).

Oxyspirura* (*O.*) *otocompsa n. sp.

Two birds belonging to the genus *Otocompsa jocosa fuscicaudata*, the southern red-wiskered Bulbub were examined for the presence of eyeworms and both were found infected with *Oxyspirura*. Altogether ten males and eleven females were collected.

The parasites are orange-coloured when freshly collected. These are medium-sized worms with their posterior extremities attenuated sharply. The head end is truncated with rounded sides. The cuticle is thin and devoid of striations. Starting from the head end a pair of membranous expansions is seen running the entire length of the body in both the sexes. They are transparent and marked with delicate transverse striae. The nerve ring and the excretory pore are seen at a distance of 0.137-0.150 mm. and 0.165-0.250 mm. from the anterior end in the male, 0.146-0.176 mm. and 0.236-0.257 mm. in the female, respectively.

The mouth is surrounded by a cuticular rim and six small papillae of which four are submedian and two lateral in position. In addition to these, there are four pairs of submedian papillae situated a little distance behind the oral opening and a pair of laterally situated amphids.

The buccal cavity measures 25μ long by 16μ wide in the male and 29μ by 18μ in the female. The oesophagus occupies $^1/_{11}$th-$^1/_{12}$th and $^1/_{11}$th-$^1/_{14}$th of the body length in the male and the female respectively ; the two portions being 0.12-0.13 mm. and 0.42-0.50 mm. long in the male and 0.13-0.16 mm. and 0.48-0.58 mm. in the female.

MALE : The males measure 6.45-7.6 mm. in length by 0.23-0.26 mm. in maximum diameter. The cloacal aperture is 0.14-0.16 mm. from the tip of the tail. The filiform testis runs straight up to a little distance behind the posterior end of the oesophagus where it recurves and pursues a backward course ending in a posteriorly directed tip in the middle of the body. It is followed by a vas deferens which is continued with the seminal vesicle. The latter in turn terminates at the cloaca.

The posterior extremity is ventrally flexed and devoid of cadual alae. It possesses seven pairs of caudal papillae of which three are precloacal. The first three postcloacals form a group immediately behind the cloacal aperture and the last pair is seen in between the tip of the tail and the third pair of postcloacal papillae. The two spicules are 0.257-0.274 mm. and 0.121-0.124 mm. in length, the left being larger, tubular and narrower and the right sole-shaped, more chitinized possessing a wide cuticular expansion all along its ventral surface.

FEMALE : The females are 6.86-10.49 mm. long by 0.29-0.41 mm. wide. The vulva is 0.56-0.60 mm. from the tip of the tail which is 0.27-0.31 mm. long There is a well-developed sphincter muscle round the vulval opening. The vagina has muscular walls measuring 0.15-0.19 mm. in length. The uteri run anteriorly, reaching the vicinity of the oesophagus where they turn back to end in ovaries. The limbs of the uteri are tightly packed with embryonated eggs 36-39μ long by 22-27μ wide.

Discussion : In having an alate right spicule, cephalic cuticular expansions and a spicule ratio of 2 : 1, the present worm resembles *O.* (*O.*) *singhi* described in this paper. The two worms differ from one another in several respects.

O. (*O.*) *singhi* has membranous alae limited to the anterior region of the body ending a little distance behind the excretory pore. The present worm possesses alae all along its body length. The number of caudal papillae are 5 pairs in the former and 7 pairs in the latter. There are 2 post-cloacal pairs in *O.* (*O.*) *singhi* and 4 pairs in the worm under discussion.

The right spicule of the latter is much stouter and broader than that of the former.

O. (*O.*) *kaitingensis* also shows affinities with the present worm in respect of its body length and the number of caudal papillae *O.* (*O.*) *kaitingensis* is said to possess six cuticular expansions of which two are smaller and four larger 'all of them extend from the level of the buccal capsule posteriorly to that of the nerve ring.' These expansions are lacking in the present worm. The two worms also differ in various other body measurements.

The writer thus regards the worm collected from *Otocompsa* as a new species. It is proposed to name it as *O.* (*O.*) *otocompsa.*

Host : *Otocompsa jocosa fuscicaudata.*
Habitat : Orbital cavity.
Locality : Hyderabad-Deccan (India).

Oxyspirura* (*O.*) *gubernaculata n. sp.

A solitary male specimen was once collected from the eye-ball of the eastern gray wagtail, *Motacilla cinerea caspica.*

This is a small worm appearing yellowish when alive. The body is slender and of uniform thickness measuring 4.5 mm. in length and 0.23 mm. in maximum diameter. The anterior end has broad rounded sides and a truncated tip but the posterior extremity is sharply attenuated. The cuticle is thin and devoid of transverse striations. The head neither possesses the cephalic lobules nor the cephalic membranous expansions present in other forms. There are four pairs of submedian and six circumoral cephalic papillae. The nerve ring is seen at 0.14 mm. and the excretory pore at 0.30 mm. from the tip of the tail. The buccal capsule has a chitinous ring-like structure at its apex and measures 19μ in length by 16μ in maximum diameter. The oesophagus is short, 0.37 mm. in length occupying $^1/_{12}$th part of the body. The distinction between its components is hardly discernible.

There are seven pairs of caudal papillae, three being precloacal and four postcloacal. The last of the postcloacals is isolated and lateral in position. The spicules are very unequal ; the left having a knob-like tip, is six and a half times as long as the right. The short spicule is dagger-shaped. The spicules measure 0.254 mm. and 0.036 mm. in length. There is a small gubernaculum with a length and breadth of 46μ and 23μ respectively. The tail is 0.120 mm. long.

Discussion : The presence of gubernaculum is reported from four species, of which three belong to the subgenus *Yorkeispirura* and the fourth *O.* (*O.*) *crassa* Caballero, 1938, to the subgenus *Oxyspirura.* The present

worm differs from *O.* (*O.*) *crassa* in several respects, the latter is more than four times as long as the former. The cervical alae are present in *O.* (*O.*) *crassa* but absent in the worm under discussion. The former has 7 pairs of precloacal and 7 pairs of postcloacal papillae, whilst *O.* (*O.*) *gubernaculata* has 3 pairs of precloacal and 4 pairs of postcloacals. The right spicule of the present worm is $^1/_6$th of its counterpart in *O.* (*O.*) *crassa* and the left spicule is half as long as that of the Mexican species.

In view of the differences observed, the present worm is regarded as belonging to a new species. It is proposed to name it *O.* (*O.*) *gubernaculata.*

Host : *Motacilla cinerea caspica.*
Habitat : Orbital cavity.
Locality : Hyderabad.

Key to the subgenera of the genus *Oxyspirura* Drasche in Stossich 1897.

Stoma divided by a constriction into two parts	...	*Yorkeispirura*
Stoma undivided	...	1
1. Spicules equal	...	*Cramispirura.*
Spicules unequal	...	*Oxyspirura.*

Key to the species

Subgenus *Yorkeispirura* Skrjabin, 1931

Head with cuticular expansions	...	1
Head without cuticular expansions	...	2
1. Male 13.54 mm. long, female 18.9 mm. ; precloacal papillae 9 pairs postcloacals 10 pairs spicule ratio 3 : 1 (L. S. 0.462 mm., R. S. 0.196 mm.)		*O. Y. octopapillata* Caballero, 1942.
Male 11-20 mm. long, female 27-30 mm. long, precloacals 2 pairs, postcloacals 6 pairs ; spicule ratio 2 : 1 (L. S. 0.420 mm. R. S. 0.227 mm.)		*O.* (*Y.*) *navali* Caballero, 1936.
2. Gubernaculum present	...	3
3. Male 13 mm., female 14 mm. ; caudal papillae asymmetrical, 5 precloacal, 7 postcloacals ; spicule ratio 2.4 : 1 (L. S. 0.6 mm. R. S. 0.25 mm.).		*O.* (*Y.*) *tanas jtchuki* Skrjabin, 1916.
Male 16.5-18 mm., female 23-26.7 mm. ; caudal papillae symmetrical, 3 pairs precloacal, 1 adanal and two pairs of postanal, ; spicule ratio 13 : 1 (L. S. 5.2-5.7 mm. alate, R. S. 0.38-0.41 mm.)		*O.* (*Y.*) *hispanica* Yeh Liangsheng, 1957.
Gubernaculum absent	...	4
4. Males 10-16 mm., females 12-19 mm. ; caudal papillae 4 pairs of precloacal, 2 pairs of postcloacals ; spicule ratio 15 : 1 (L. S. 3-3.5 mm., R. S. 0.200-0.220 mm.).		*O.* (*Y.*) *mansoni* (Cobbold 1879) Ransom, 1904.

Males 7.7-9.1 mm., females 9.3-11.7 mm. caudal papillae 3 pairs of precloacal and 3 pairs of postcloacals, spicule ratio 10 : 1 (L. S. 0.20-0.25 mm., R. S. 2.06-2.25 mm.)	*O.* (*Y.*) *tsingchengensis* Hsu, 1933.

Subgenus *Cramispirura* Skrjabin 1931

Caudal papillae 3 pairs of preanal, one pair of adanal and 3 pairs of postanals, Spicules 0.138 and 0.155 mm.	*O.* (*C.*) *popovi* (Skrjabin, 1929) Skrjabin, 1931.
Caudal papillae 4 pairs preanal, and 2 pairs of postanals, adanals absent. Spicules 0.12 and 0.14 mm.	*O.* (*C.*) *baskakowi* (Skrjabin, 1929) Skrjabin, 1931.

Subgenus *Oxyspirura* Drasche in Stossich, 1897

Head with cuticular expansions	...	1
Head without cuticular expanions	...	8
1. One spicule alate	...	2
Both the spicules non-alate	...	6
2. Right spicule alate, spicule ratio 1 : 2	...	3
Right spicule non-alate	...	4
3. Right spicule narrow with curved tip Caudal papillae 3 pairs precloacal and 2 pairs postcloacal.		*O.* (*O.*) *singhi* n. sp.
Right spicule broad and sole-shaped Caudal papillae 3 pairs precloacal and 4 pairs of postcloacal.		*O.* (*O.*) *otocompsa* n. sp.
4. Males more than 10 mm. long (13-15 mm.) Caudal papillae more than 7 pairs (7 pairs precloacal and 6 pairs of postcloacals).		*O.* (*O.*) *cephaloptera*. (Molin, 1860) Stossich, 1897.
Males smaller, fewer caudal papillae	...	5
5. Males 5.8-6.1 mm. long, 3 pairs precloacal, 4 pairs postcloacal, spicule ratio 2.5 : 1 (L. S. 0.3-0.41 mm., R. S. 0.14-0.148 mm.)		*O.* (*O.*) *kaitingensis* Hsu, 1933.
Males 8.10 mm. long, 2 pairs precloacal 5 pairs of postcloacals, spicule ratio 5 : 1		*O.* (*O.*) *anacanthura* (Molin, 1860) Stossich, 1897.
6. Males less than 5 mm. (4.3 mm.) long, 3 pairs of precloacal, 5 pairs of postcloacals.		*O.* (*O.*) *hyderabadensis* n. sp.
Males much longer, 4 pairs of precloacal papillae		7
7. Males 8.94 mm. long, 3 pairs of postcloacals	...	*O.* (*O.*) *buccosulcata* Singh, 1948.

	Males 15 mm. long, 8 pairs of postcloacals ...	*O.* (*O.*) *brevisubulata* (Molin, 1860) Stossich, 1897.
8.	Males less than 10 mm. long ...	9
	Males more than 10 mm. long ...	14
9.	Gubernaculum present, 3 pairs of precloacal papillae, 4 pairs of postcloacals, Males 4.5 mm.	*O.* (*O.*) *gubernaculata* n. sp.
	Gubernaculum absent ...	10
10.	28 (?) pairs of precloacal papillae males 8.9 mm., females 9.8 mm.	*O.* (*O.*) *siamensis* (Linstow, 1903) Ransom, 1904.
	Fewer pairs of preanal papillae ...	11
11.	Female tail without a pair of papillae, 3 pairs of precloacal, 5 pairs of postcloacal; Males 8 mm. long.	*O.* (*O.*) *Crami* Khalil, 1932.
	Female tail with lateral papillae. Fewer pairs of postcloacals.	12
12.	Male 3.1 mm. long, 2 pairs of precloacal papillae.	*O.* (*O.*) *myzomelae* Baylis, 1935.
	Males longer, more than 2 pairs of precloacal papillae.	13
13.	Males 6.1 mm., females 9.2 mm., 4 pairs of postcloacal papillae.	*O.* (*O.*) *petrowi* (Skrjabin, 1929) Skrjabin, 1931.
	Males 7.2-9.7 mm., long, females 12.3 mm., 3 pairs of postcloacal papillae.	*O.* (*O.*) *peipingensis* Hsu, 1933.
14.	Gubernaculum present, Males 18-20 mm. long (L. S. 0.45-0.54 mm., R. S. 0.17-0.18 mm.)	*O.* (*O.*) *crassa* Caballero, 1938.
	Gubernaculum absent Males smaller (less than 18 mm.) ...	15
15.	Left spicule one and half times as long as the right Male 14.4 mm. long, female 21 mm. long, L. S. 0.290 mm., R. S. 0.180 mm.	*O.* (*O.*) *ophthalmica* (Linstow 1903) Ransom, 1904.
	Left spicule twice as long as the right or more ...	16
16.	Left spicule twice as long as Right spicule (L. S. 0.43 R. S. 0.20), one pair of precloacal and one pair of postcloacal.	*O.* (*O.*) *toroi* Caballero, 1937.
	Left spicule two and a half times as long as right spicule.	17

17. Precloacal papillae absent 4 pairs of postcloacal. left spicule alate.	*O.* (*O.*) *sygmoidea* (Molin, 1860) Stossich, 1897.
3 pairs of precloacals ...	18
18. Males 12-13 mm. long, females 15-18 mm. long, L. S. 0.4 mm. R. S. 0.16 mm., left spicule with narrow alae in distal third.	*O.* (*O.*) *streperae* Johnston & Mawson, 1941.
Males 14.5 mm. long, females 15.5 mm. -19 mm. long, L. S. 0.71 mm., R. S. 0.31 mm.	*O.* (*O.*) *schulzi* (Skrjabin, 1929) Skrjabin, 1931.

Tetrameriidae Travassos, 1914

Creplin established the genus *Tetrameres* in 1846 for the worm described by Diesing (1835) as *Tropisurus paradoxus* and *Tropidocerca paradoxa* (Dies., 1835) Diesing, 1851. Travassos in 1941, divided the genus into two subgenera, *Tetrameres* and *Microtetrameres* ; the latter being erected on the characteristics exhibited by *T. cruzi*. In the subsequent year (1915) Railliet instituted the subfamily Tetramerinae to accommodate the two subgenera. Cram not only raised the two subgenera to the generic ranks but also redetermined their diagnosis. Travassos had identified the two groups on the basis of the body form of the females, the proportionate length of the spicules and the presence or absence of spines in the males. Cram regarded the proportionate length of the spicules as an unsuitable basis for the separation of the two genera. She accepted the body form of the female as the only criterion suitable for the differentiation and rejected the presence or absence of the spines as a basis for classification. The writer while agreeing with Cram in rejecting the spicule ratio as a sound characteristic, finds herself in agreement with Travassos in regarding the presence or absence of spines also as a valid feature. No *Microtetrameres* has so far been reported as possessing spines nor any known *Tetrameres* is completely devoid of this structure, which is present on some portion of the body or the other. *T. gynaecophila* is reported as being devoid of spines, but the presence of '7 sessile preanal papillae and one adanal pair with two pairs of postanals' creates a doubt as to whether the structures reported were papillae or poorly developed spines. The species is also said to have no spicules, a very unique exception in the tetramerids reported so far.

In 1950, Gubanov erected a new subgenus for *T. gynaecophila* on the basis that the entire body is devoid of spines. He also described a new species under the subgenus *Gynaecophila* as *T.* (*G.*) *sobolevi*. In 1953, Shigin added a third species *T.* (*G.*) *ardeae* to this subgenus. The writer

collected the last mentioned species from the same host, *Ardea cinerea*. The tetramerid apparently seems to be devoid of spines but its examination under high magnification exhibits clearly the existence of very poorly developed spines found stretching only in the left lateral field. Not only is their size reduced, but they are completely absent on the right lateral field. Their number is also very much reduced. In all the three worms reported by the writer in this paper, this phenomenon is commonly observed. The first observation is very confusing and there is every possibility of this structure having been overlooked in *T. fermini* Perez and Vigueras, 1935, *T. sobolevi* Gubanov, 1950 and *T. ardeae* Shigin, 1953. A detailed study brings to light the gradual change from thickly spined condition in the majority of tetramerids where four well-developed rows of spines are found to *T. pattersoni* and *T. paradoxa* in which two rows of spines are present. A further reduction of spines is exhibited by *T. dubia* where the spines are restricted only to the anterior region. In *T. microspinosa* a further detriment is evident by the presence of two rows of very minute spines. Ultimately in *T. gynaecophila*, *T. fermini* and *T. ardeae* the spines are so much reduced that the parasite apparently seems to be devoid of this structure which are seen only under high magnification. Thus the last mentioned parasites exhibit a very close affinity with *Microtetrameres*. Another important fact is, that the body form of the females of *T. ardeae*, *T. microspinosa*, *T. fermini* and some other species of *Tetrameres* like *T. nouveli* are subglobular, a condition closer to the females of *Microtetrameres*. So there seems to be a transformation also in the female body from globular and furrowed condition to subglobular and ultimately to leaf-like spirally coiled form. The relationship between the two groups is very close yet the changed body form of the female and the presence of spines on the body of the male are two valid factors determining the distinction between the two genera.

Genus ***Tetrameres*** Creplin, 1846.

Generic diagnosis : Males with spines in the lateral fields. Female body globular or subglobular.

Gubanov, 1950, divided the genus into two subgenera on the basis of the presence or absence of cuticular spines on the body. The subgenera being *Tetrameres* and *Gynaecophila*. In 1953, Chertkova created the third subgenus, *Petrowimeres*, for her worm from *Pavo cristatus*. Chertkova has compared her worm with *T. fissispina* which also possesses the cleft spines on either side of the head. There is a controversy regarding their nature. Lieberkuehn regards them to be the 'duplicature of the cuticle.' Hence it is not safe to accept this characteristic as sound for the classification.

In the writer's opinion the presence of cordons on the male body would be a more valid diagnostic feature of the subgenus. So far this structure is reported from *T. mohtedai* Bhalerao and Rao 1944. Chertkova has drawn this structure in the figure of her worm. The writer also reports a worm which possesses a pair of cordons. Hence the substitution of the latter characteristic for the former in the diagnosis of the subgenus. In 1931, Maplestone described a worm from a Dun bird *Aythya ferira* and an unidentified duck as *Echinuria spinosa.* In the discussion Maplestone states that 'the worm closely resembles certain males of the genus *Tetrameres*' but 'as no species of *Tetrameres* have cordons and in the absence of the females it is considered advisable to place it in the genus *Echinuria.*' *T. mohtedai* Bhalerao and Rao, 1944 and *T. pavonis* Chertkova, 1953, resemble Maplestone's worm and are accepted as *Tetrameres.* There are basic structural differences between *Tetrameres* and *Echinuria.* The cordons of *Echinuria* anastomose posteriorly in pairs in the lateral fields but in the case of these worms the cordons do not anastomose and are of a different structure. The anterior portion of the cordons expands in a fan like fashion and posteriorly they run in a form of a streak. They do not possess the typical conical lips of Acuariinae. In almost all *Echinuria* the buccal capsule is absent and they possess well-developed caudal alae ; both these characters are lacking in *Tetrameres.* Hence the writer feels that Maplestone's worm should also be transferred to the subgenus *Petrowimeres* and be named as *Tetrameres* (*Petrowimeres*) *spinosa.* It is proposed to retain the name of the subgenus but as *T.* (*P.*) *spinosa* has the priority of time, it is to be regarded as its type species.

Key to the subgenera.

1. Males with a pair of cordons ... *Petrowimeres* Chertkova, 1953.
   Males devoid of cordons ... 2
2. Body with well-developed rows of spines. *Tetrameres* (Criplin, 1846) Gubanov, 1950.
   Body with feebly developed spines. *Gynaecophila,* Gubanov, 1950.

There are altogether thirty-seven species of *Tetrameres* reported so far, of which *T. mohtedai, T. pavonis* and *T. spinosa* are assigned to *Petrowimeres,* one more new species is being added by the writer. *T. gynaecophila, T. fermini, T. sobolevi* and *T. ardeae* are assorted to *Gynaecophila,* the writer is also contributing two more new species. The rest of the known species are retained in *Tetrameres.** A new species of this subgenus is also reported.

*(1) *T. paradoxa* (Dies., 1835) Travassos, 1914, (2) *T. coccinea* (Seurat, 1914) Travassos, 1914, (3) *T. nouveli* (Seurat, 1914) Travassos, 1914, (4) *T. unispina* (Dies., 1861) Travassos, 1914, (5) *T. certa* (Leidy, 1886) Travassos, 1914, (6) *T. fissispina* (Dies.,

T. certa (Leidy, 1886) Travassos, 1914, is not included in the present key due to its generic position being doubtful. The males of *T. unispina* (Diesing, 1861) Travassos, 1914*d* and *T. diomedeae* Johnston and Mawson, 1942, are unknown, hence their omission. Unfortunately the writer could not get the literature of *T. travassosi* Skrjabin (1920 ?) 1930, *T. skrjabini* Panow, 1926 and *T. cubana* Perez Vigueras, 1941. The description of the male *T. crami* Swales, 1933, also was not available.

Tetrameres (*Tetrameres*) *monospicules* n. sp.

Three males and a single female of this parasite were once collected from the purple Moor Hen, *Porphyrio poliocephalus*. The males were picked up from the lumen where they lie free but the females had to be squeezed out of the glands of proventriculus. The males are filiform and the female has a globular body.

Male : The males are very slender, with a cylindrical body and tapering ends, the posterior being more sharply attenuated than the anterior. The body length ranges from 2.38-2.6 mm. with a maximum diameter of 0.12-0.13 mm. The cuticle is thin and finely striated. The transverse striations are 9μ apart. There are four rows of well-developed spines, two being lateral and the two median in position. The spines are 17μ long in the anterior region of the body but gradually diminish in size and become more sparsely separated, running all along the length of the body. There are five pairs of postcloacal spines, much modified in the shapes, being thin with club-shaped ends. Four or five spines in front of the cloaca also assume the same shape. The excretory pore opens at a distance of 0.170 mm. from the tip of the head. The mouth is surrounded by six pseudolabia each of which bears a papilla. In addition to these there are present four submedian papillae and a pair of laterally situated amphids. The buccal capsule is small, broader than long and measures 11-13μ long by 13-25μ in miximum width. The oesophagus is divided into two parts,

1861) Travassos, 1914, (7) *T. globosa* (Linstow, 1879) Travassos, 1914, (8) *T. micropenis* Travassos, 1915, (9) *T. tetrica* Travassos, 1917, (10) *T. dubia* Travassos, 1917, (11) *T. cochleariae* Travassos, 1917, (12) *T. gigas* Travassos, 1919, (13) *T. confusa* Travassos, 1919, (14) *T. skrjabini* Panowa, 1926, (15) *T. zakharowi* Petrow, 1926, (16) *T. americana* Gram, 1927, (17) *T. hagenbecki* Travassos and Vogelsang, 1929, (18) *T. travassosi* Skrjabin, 1930, (1920 ?), (19) *T. paradisea* Ortlepp, 1932, (20) *T. crami* Swales, 1933, (21) *T. pattersoni* Cram, 1933, (22) *T. microspinosa*, Perez Vigueras, 1935, (23) *T. scolopacis* Yamaguti, 1935, (24) *T. cubana* Perez Vigueras, 1941, (25) *T. australis* Johnston and Mawson, 1941, (26) *T. biziurae* Johnston and Mawson, 1941, (27) *T. diomedeae* Johnston Mawson, 1942, (28) *T. pelecani* Johnston and Mawson, 1942, (29) *T. grusi* Shumakovich, 1946, (30) *T. pochovi* Gushanskaya, 1949, (Syn. *T. Crami* of Puchov, 1939).

0.206-0.212 mm. and 0.511-0.518 mm. long respectively. The entire organ occupies $^1/_3$rd of the body length.

The filiform testis lies in the anterior half of the body extending up to the junction of the oesophagus with the intestine, and recurves to end in a posteriorly directed tip. The tail is 0.08-0.13 mm. long and devoid of alae. There is a single spicule measuring 0.25-0.33 mm. long. It possesses a ridge 67μ from the tip which is notched.

FEMALE : The female is blood-red in colour when freshly collected. The body is sub-globular without lateral cuticular expansions but with four deep furrows corresponding to the longitudinal and median lines, and its cuticle being thrown into wrinkles. The body is 2.16 mm. long by 0.639 mm. wide. The buccal capsule is barrel-shaped and is 16μ long and 23μ wide. The excretory pore and nerve ring are seen at 0.175 mm. and 0.140 mm. from the head end. The two portions of the oesophagus are 0.180 mm. and 0.49 mm. long occupying $^1/_3$rd part of the body. The dilated body is full of eggs, measuring 34μ long by 27μ wide. The vulva opens at a distance of 0.277 mm. from the tip of the tail. The tail is sharply pointed measuring 0.153 mm. in length.

Discussion : Out of the known species of the genus *Tetrameres* the following are reported to possess a single spicule. These are *T. nouveli* (Seurat, 1914) Travassos, 1914, *T. pattersoni* Cram, 1933 *T. crami** Puchov, 1939, *T. paradisea* Ortlepp, 1938, and *T. grusi* Shumakovich, 1946. The present worm differs from all of them in the following respects. As against the present worm *T. pattersoni*, *T. nouveli* and *T. paradisea* have alate spicules. *T. paradisea* and *T. crami* of Puchov are reported to have gorgeret or rudiment of the right spicule but no such structure is observed in the worm under discussion. Their spicules are twice and half as long as that of *T. monospicu'es* respectively. While there are only two rows of spines on the body of *T. pattersoni*, there are four in the present worm. The spicule of the former is four times as long as that of the latter. *T. grusi* is one and a half to two times longer and its spicule twice as big as that of the present worm.

Taking into account the various differences, *T. monospicules* is regarded as a new species.

* '*T. crami* of Puchov, 1939, is quoted as a synonym of *T. puchovi* Gushanskaya, 1949 (the respective reference is not quoted which is a homonym of *T. crami* Swales 1933.') (Helm, Abst. 1951).

Host : *Porphyrio poliocephalus.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Tetrameres* (*Gynaecophila*) *ardeae Shigin, 1953.

A dozen males and as many female specimens of this species were collected from the proventriculus of the eastern grey heron, *Ardea cinerea.* The white-coloured males are found free in the lumen and the blood-red females had to be squeezed out from the cysts, formed in the proventriculus.

MALE : The males are small with filiform bodies measuring 2.78-3.25 mm. in length and 0.097-0.141 mm. in maximum diameter. The head is not so much attenuated as the tail end. The cuticle is thin and finely striated, the striae being 8μ apart in the middle region. The excretory pore opens at the level of the nerve ring which is about 0.15-0.18 mm. from the head end. The cervical papillae could not be located even after prolonged search. The head bears two concentric rows of papillae, the inner having six smaller papillae surrounding the mouth and the outer possessing four larger papillae in the submedian position and a pair of laterally situated amphids. The oesophagus is 0.92-1.02 mm. long and occupies $^1/_3$rd of the body length. The muscular and the glandular portions of the oecophagus are 0.20-0.216 mm. and 0.72-0.81 mm. long.

There is a single testis running up to the oesophageal region, where it recurves and pursues a backward course to end in a knob-like posteriorly directed tip. It is followed by the vas deferens which leads into the seminal vesicle. The latter opens by means of a short ejaculatory duct into the cloaca.

The tail tapers sharply to end in a bluntly rounded tip. The cloacal aperture is 0.120-0.20 mm. from the tip of the tail. There are four pairs of postcloacal papillae on the ventral surface of the tail. The precloacal papillae being two pairs only, on the left side of the body anterior to the cloacal aperture, there are present very minute spike-like structures located at intervals of 0.057 mm. There are altogether 27-35 poorly developed spine-like structures present up to the posterior region of the oesophagus. The right lateral field of the body and both the sides of the tail are devoid of these structures. The spicules are very unequal being 0.89-1.28 mm. and 0.06-0.10 mm. long. The left is the longer and 10-14 times the length of the right. Both the spicules are forked at their tips.

FEMALE : The body of the female is sub-globular with both the ends sharply attenuated. The cuticle is deeply striated and has furrows which are characteristically present in *Tetrameres.*

The body measures 3.4-4.6 mm. in length and 0.97-1.2 mm. in maximum diameter. The excretory pore is located adjacent to the nerve ring which surrounds the oesophagus at 0.20 mm. from the head end. The buccal capsule is more or less barrel-shaped measuring 14-16μ in length and 10-12μ in its maximum width. The two portions of the oesophagus measure 0.185 mm. and 0·699 mm. in length, the total length occupying $^1/_3$rd of the entire body.

The tail is 0.115-0.165 mm. long. The vulva opens in a depression forming an angle between the body and the sharply pointed tail which is 0.20-0.25 mm. long. The vagina is directed anteriorly. It is a short tube connected with the uteri which are tightly packed with the eggs which are elliptical and measure 40μ long by 16μ wide. They are thick-shelled and bioperculate.

Discussion : Gubanov, 1950, raised *Tetrameres gynaecophila* (Molin, 1858, emend. Diesing, 1861) Travassos, 1914, to the subgeneric rank and also included in it his new species *T. sobolevi.* In 1953, Shigin added one more species, *T. ardeae* to the list. The present species is being reported from the same host, *Ardea cinerea.* In all the body measurements, in possessing two pairs of precloacal and four pairs of postcloacal papillae, in having a gubernaculum, it is identical with the Russian worm. The present worm, however, has 27-35 laterally situated, feebly developed, sparsely placed 'spines' present only in the left lateral field, starting from a little distance behind the cervical region, up to the precloacal portion of the body. These structures are seen only under high magnification and are liable of being overlooked. The writer regards the two worms as belonging to the same species.

Host : *Ardea cinerea.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Tetrameres* (*Gynaecophila*) *minutes n. sp.

A solitary male was picked up once from the lumen of the proventriculus of the Indian Pond Heron, *Ardeola grayii.*

The worm is of a small size being 1.92 mm. long and 0.16 mm. wide. The body is filiform having attenuated ends. The head is marked off from the rest of the body by a constriction at the level of the base of buccal capsule. The tail ends in a bluntly rounded knob-like tip. The cuticle is thin and faintly striated. There are altogether 14 inconspicuous and poorly developed spines in the left lateral field. The excretory pore opens adjacent to the

nerve ring which surrounds the anterior region of the oesophagus at 0.156 mm. from the head end. The mouth is surrounded by 8 pairs of prominent papillae arranged in two rows, the circumoral row has six papillae and the outer row has two pairs of submedians and a pair of lateral amphids. The buccal capsule is distinctly divided into a very small, but broad, anterior region and a long barrel-shaped posterior portion measuring 23μ in length and 14μ in maximum diameter.

The oesophagus is divided into a muscular and a glandular portion measuring 0.23 mm. and 0.40 mm. in length, the entire organ being 0.64 mm. long, occupying $^1/_3$rd of the body length.

The tail is 0.168 mm. long, ending in a bluntly rounded knob-like tip. There are four pairs of postcloacal papillae arranged in the subventral position. The precloacal papillae are absent being replaced by the spines in the left lateral field. The spicules are unequal the left being 0.373 mm. long and the right 0.073 mm. A small gubernaculum with unequal arms measuring 19μ long and 18μ wide, is also present. The cloacal aperture is guarded by prominent lips, which, in the ventral position, look like 'Circumcloacal alae.'

Discussion : This is the smallest parasite of the subgenus *Gynaecophila.* It differs from the others in having a spindle-shaped body with cephalic region distinctly marked off from it and by the absence of preanal papillae. The shape of its buccal capsule also differs from all the rest. Its spicule ratio differs from those of *T.* (*G.*) *sobolevi* and *T.* (*G.*) *ardeae* in being 5 : 1 as against 10 : 1 and 13 : 1 respectively. Taking into account these differences, the present worm is regarded as constituting a new species. It is proposed to name it *T.* (*G.*) *minutes* n. sp.

Host : *Ardeola grayii.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Tetrameres* (*Gynaecophila*) *singhi n. sp.

In December 1956, two males of this species were collected from the proventriculus of the white stork *Ciconia ciconia.*

The live worm is milky white in colour. It is fairly stout measuring 7.38 mm. in length and 0.25 mm. in thickness. The dorsoventral diameter of the head is 0.026 mm. The cuticle is strongly striated, the striae being 9μ apart in the middle of the body. It also bears a series of vertical ridges between the transverse striae. The left lateral field possesses very poorly developed spines numbering up to seven. The excretory pore opens at a distance of 0.139 mm. from the anterior end. The anterior region of the

muscular portion of the oesophagus is surrounded by the nerve ring at about 0.129 mm. from the head end. The head bears three pairs of small papillae surrounding the oral opening and two pairs of prominent submedian papillae with two lateral amphids. The buccal capsule is 34μ deep and 18μ wide. It leads into the muscular portion of the oesophagus which measures 0.36 mm. in length, the posterior glandular portion which follows this is 1.24 mm. long. The entire oesophagus thus occupies roughly $^1/_5$th of the body length.

The tail is 0.275 mm. long and ends in a bluntly rounded tip. It is devoid of caudal alae and bears 4 pairs of ventrally situated postcloacal papillae, the precloacals being absent. The spicules are extremely unequal. The left is 6.08 mm. long and the right 0.127 mm. in the length thus having a length ratio of 51 : 1. There is a thick cuticular sheath round the tip of the left spicule which is bifurcated. There is a gubernaculum 39μ long by 34μ wide. A pair of phasmids is seen at 0.20 mm. from the tip of the tail.

Discussion : This species exhibits close affinities with *T.* (*G.*) *sobolevi* and *T.* (*G.*) *gynaecophila* in its body length, but differs from both in being the thinnest (0.25 mm. against 0.6 mm). It has four pairs of post-cloacal papillae as against two pairs of postcloacal, one pair of adanal and 6 or 7 pairs of precloacals in *T.* (*G.*) *gynaecophila* and eight pairs of post-cloacals and two pairs of precloacals in *T. sobolevi.* Moreover, the present worm has the longest spicules, which are absent in *T.* (*G.*) *gynaecophila* and smallest in *T.* (*G.*) *sobolevi.* The ratio between the lengths of the spicules is 10 : 1 in *T.* (*G.*) *sobolevi* and 51 : 1 in the worm under discussion. The differences are so prominent that the worm is regarded as a new species. It is proposed to name it *T.* (*G.*) *singhi* after Professor S. N. Singh.

Host : *Ciconia ciconia.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Tetrameres* (*Petrowimeres*) *cordoniferens n. sp.

A solitary male worm was once picked up from the lumen of the proventriculus of the lesser or common whistling teal, *Dendrocygna javanica.*

This is a small slender worm with cylindrical body tapering both at the anterior as well as the posterior end ; the anterior extremity being less attenuated than the posterior which is sharply pointed. The body measures 3.5 mm. long by 0.11 mm. wide. There are four rows of spines which are feebly chitinized and irregularly displaced. The spines are in the anterior region up to 0.187 mm. from the head end, where they disappear and are seen again a little distance in front of the cloaca. The tail possesses five pairs of very lightly chitinized ventral and three pairs of lateral spines. A

pair of phasmids is seen at a distance of 0.058 mm. from the tip of the tail. A very unusual structure—a pair of cordons—is present on the body of this worm, starting from the bases of the lips in the dorsoventral surfaces they pursue a backward course and run almost all along the length of the body ending a little distance in front of the cloaca. The cordons are wide at their anterior ends, but become streak-like as they reach the posterior third of the body. They are clearly seen and prominently displayed.

The excretory pore opens at 0.23 mm. from the anterior extremity. The nerve ring in seen surrounding the anterior portion of the oesophagus at 0.159 mm. from the head end. The cervical papillae could not be located even after prolonged search.

The mouth is surrounded by pseudolabia which are not well marked off. There are 3 pairs of papillae situated circumorally and one pair of submedians on each lip. The lateral amphids are also to be seen clearly. The buccal cavity which is 19μ deep and 13μ wide, has a transparent band across its base. The oesophagus is clearly divided into two parts, an anterior muscular and a posterior glandular portion, the lengths being 0.134 mm. and 0.99 mm. respectively, occupying $^1/_3$rd portion of the entire body length.

The tail is devoid of alae, measuring 0.13 mm. in length, its tip being marked off from the rest of the body by a slight constriction. The cloaca possesses well-developed cuticular lips. The spicules are very lightly chitinized, the smaller being only detected under the oil immersion lens. The left spicule has a peculiar shape, usually not met with in this genus, the proximal end is rounded but the distal part is somewhat spear-shaped. The two spicules measure 0.40 mm. and 0.064 mm. respectively.

Discussion : The present worm differs from the other species of the subgenus in the following respects. This is the smallest of the three species. It differs from *T. (P.) pavonis* in having a non-alate left spicule and in the spicule ratio (4 : 1 as against 6 : 1). *T. (P.) mohtedai* possesses shorter cordons and also differs from the present worm in several body measurements. It differs from *T. (P.) spinosa* in the length of the body, cordons and various other measurements.

In view of the differences exhibited, the present worm is regarded as belonging to a new species and the name *T. (P.) cordoniferens* is proposed for it.

Host : *Dendrocygna javanica*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Key to the species of the genus Tetrameres, Creplin, 1846

Subgenus *Tetrameres* Creplin, 1846.

	Spines limited to the anterior region of the male.	*T.* (*T.*) *dubia* Travassos, 1917*a*.
	Spines not limited to the anterior region of the male.	1
1.	Spines minute, not well-developed ...	*T.* (*T.*) *microspinosa* Perez Vigueras, 1935.
	Spines well-developed ...	2
2.	Left spicule present, rudiments of the right spicule present or absent.	3
	Both spicules present ...	8
3.	Shields present on the ventral surface of the body	4
	Ventral shields absent ...	5
4.	Spicule alate ...	*T.* (*T.*) *paradisea* Ortlepp, 1932.
	Spicule nonalate ...	*T.* (*T.*) *grusi* Shumakovich, 1946.
5.	Rudiments of right spicule present ...	6
	Rudiments of right spicule absent ...	7
6.	Spicule 0.307 mm., tail 187μ long ...	**T.* (*T.*) *puchovi* Gushanskaya, 1949.
	Spicule alate 0.48 mm., tail 110μ long. Eggs with polar filaments.	*T.* (*T.*) *nouveli* (Seurat, 1914). Travassos, 1914*a*.
7.	Two rows of spines present on the body. Males 4.2-4.6 mm. long, spicule 1.2-1.5 mm. long.	*T.* (*T.*) *pattersoni* Gram, 1933.
	Four rows of spines on the body. Males 2.3-2.6 mm. long, spicule 0.3-0.32 mm.	*T.* (*T.*) *monospicules* n. sp.
8.	Lateral alae present in the male ...	9
	Lateral alae absent ...	11
9.	Gubernaculum present males 7.8-9.0 mm. L. S. 5.8-6.3, R.S. 0.8 mm.	*T.* (*T.*) *australis* Johnston and Mawson, 1941.
	Gubernaculum absent ...	10
10.	Males 3-6 mm. Buccal capsule 8μ by 3μ. †Spicules 82-150μ and 280-490μ Female tail 0.071 mm.	*T.* (*T.*) *fissispina* (Dies. 1861) Trávassos, 1914.

**T. crami* of Puchov 1939 synonym of *T. puchovi* Gushanskaya, 1949.

†Length of the spicules varies as follows :
Seurat **150** and 320μ, Wharton **115** and 320μ, Travassos, 82 and 490μ, Railliet, 88 and 280μ. The above lengths indicate the range.

	Males 4.2-4.4 mm., buccal capsule 30μ by 4μ Spicule 70μ and 250-260μ Female tail 0.5 mm. (?)	*T.* (*T.*) *biziurae* Johnston and Mawson, 1941.
11.	Male tail with narrow caudal alae, Female tail with, six terminal spines and a pair of papillae	; *T.* (*T.*) *pelecani* Johnston and Mawson, 1942.
	Male tail without caudal alae ...	12
12.	Caudal papillae in the male absent or apparently very small, spicules 0.74 and 0.016 mm.	*T.* (*T.*) *gigas* Travassos, 1919.
	Male tail with caudal papillae or spines ...	13
13.	Males more than 6 mm. long ...	14
	Males less than 6 mm. long ...	15
14.	Males 12-15 mm. long, L. S. 3 mm., R. S. 0.48 mm. long, one pair of postanal papillae or spines in the male.	*T.* (*T.*) *paradoxa* (Dies. 1835) Travassos, 1914*d*.
	Male 9.4 mm. long, L. S. 1.02 mm. long R. S. 0.19 mm. More than one pair of caudal spines or papillae in the male.	*T.* (*T.*) *zakharowi* Petrow, 1926.
15.	Ventral shields present on the body (Males 3.1-3.4 mm., L. S. 0.68, R. S. 0.032).	*T.* (*T.*) *hagenbecki* Travassos and Vogelsang, 1929.
	Ventral shields absent ...	16
16.	Two pairs of ventral caudal spines present in the male (Males 4-5 mm. long L. S. 0.35, R. S. 0.056 mm.)	*T.* (*T.*) *micropenis* Travassos, 1915*b*.
	Five pairs of ventral caudal spines or papillae present.	17
17.	Males 4-5 mm., L. S. 0.29 mm., R. S. 0.068 mm., 3 pairs of lateral caudal spines in male, oesophagus $^1/_4$th of the body length.	*T.* (*T.*) *confusa* Travassos, 1919*b*.
	Male 5.5 mm., L. S. 0.312 mm., R. S. 0.100 mm., lateral caudal spines not described or drawn oesophagus $^1/_4$th-$^1/_5$th.	*T.* (*T.*) *americana* Cram, 1927.

Subgenus *Gynaecophila* Gubanov, 1950.

Males and females in a common cyst ...	1
Males free in the lumen and females in cyst ..	?

1. Male without spicules ...	*T.* (*G.*) *gynaecophila** (Molin, 1858), Emand. (Diesing 1861) Travassos, 1914
Male with spicules (R. S. 0.22, L. S. 2.1) Male 8.7 mm., 2 preanal and 8 postanal caudal papillae.	*T.* (*G.*) *sobolevi* Gubanov 1950.
2. Gubernaculum present ...	3
Gubernaculum absent ; 3 pairs of postcloacal papillae, Male 2.5 spicules 73μ and 23.4 mm. long.	*T.* (*G.*) *fermini* Perez Vigueras, 1935 n. comb.
3. Males long, (7.3 mm.) spicules ratio 1 : 51 (R. S. 0.12 mm., L. S. 6.08 mm.).	*T.* (*G.*) *singhi* n. sp.
Males smaller, less than half as long as the above.	4
4. Male 1.9 mm., spicule ratio 1 : 5 (R. S. 0.07 mm., L. S. 0.37 mm.)	*T.* (*G.*) *minutes* n. sp.
Males 2.9-3.2 mm. spicule ratio 1 : 13 (R. S. 0.11 mm., L. S. 1.4-1.5 mm.)	*T.* (*G.*) *ardeae* Shigin, 1953.
Subgenus *Petrowimeres* Chertkova, 1953.	
Left spicule alate, Male 4.7 mm., spicule ratio 1 : 4 (R. S. 0.10 mm., L. S. 0.43 mm.)	*T.* (*P.*) *pavonis* Chertkova, 1953.
Left spicule nonalate ...	1
1. Cordons short confined to the anterior region ...	*T.* (*P.*) *spinosa* (Maplestone, 1931). n. comb.
Cordons long not confined to the anterior region	2
2. Cordons upto $^1/_3$rd body length, ventral shields absent, spicule ratio 1 : 3 (R. S. 0.14-0.16 mm., L. S. 0.39-0.48 mm.), Males 4.2-5.8 mm.	*T.* (*P.*) *mohtedai* (Bhalerao and Rao, 1944,) n. Comb.
Cordons more than $^3/_4$th body length, ventral shield present spicule ratio 1 : 6 (R. S. 0.064 mm. L. S. 0.40 mm.), Male 3.5 mm.	*T.* (*P.*) *cordoniferens* n. sp.

*According to Gubanov (1950) males and females are found in a common cyst, but Cram (1927) makes no mention of this fact.

Wehr, 1934, reported the co-existence of adult maleand female of an unidentified species of *Tetrameres* from Florida Grackle.

Genus *Microtetrameres* Travassos, 1915*b*.

In 1915, Travassos established the subgenus *Microtetrameres* for *Tetrameres cruzi* which he had described just the previous year (1914). Cram raised the subgenus to the generic rank in 1927. Only seven species of the genus, *M. cruzi* (Travassos, 1914) Travassos, 1915*b*, *M. contorta* (Weidman, 1913) Travassos, Travassos, 1915, *M. minima* (Travassos, 1914) Travassos, 1915, *M. spiralis* (Seurat, 1915) Travassos, 1915, *M. pusilla* Travassos, 1915, *M. inermis* (Linstow, 1879, Travassos, 1915, and *M. helix* Cram, 1927, were known till the publication of the Cram's paper. After about 18 years Sulmanov (1945) added another species *M. gubernaculiferens* from Tashkant (Russia). In 1953, four new species, *M. bubo*, *M. accipiter*, *M. aquila* and *M. corex* were reported by Schell from U.S.A. Boyd, E. E., described another American species in 1956 as *M. spiculata* and in the same year (1956), Mawson contributed *M. canadensis* to the genus.

Thus altogether 14 species of the genus are known up to the present date. Five more species are now being added to the genus.

In the writer's collection three worms exhibited the presence of gubernaculum, a characteristic not usually met with in *Microtetrameres*. As this structure is a common feature in all the three species and is also reported by Sulmanov in *M. gubernaculiferens*, it is thought advisable to group them all under a new subgenus, *Gubernacules*. As the Russian species has the priority of time, it is regarded as its genotype but unfortunately could not be included in the key due to the fact that Sulmanov reported the species 'without any description', the only characteristic regarding the presence of gubernaculum is indicated by its name.

Tetrameridae : Travassos, 1914.
TETRAMERINAE : Railliet, 1915.
Microtetrameres : Travassos, 1915.

Microtetrameres* (*Microtetrameres*) *Travassosi n. sp.

One male and three females of this species were collected from the southern grackle, *Gracula religiosa*. The male was found lying free in the lumen of the proventriculus, while the females were buried in the Lieberkuehn's glands. The two sexes exhibit dimorphism characteristic of the genus, the male being filiform and the female fusiform and spirally coiled.

MALE : The male is a slender worm whitish in colour, measuring 3.812 mm. in length and 0.11 mm. in maximum diameter. The cuticle is finely striated, the striae being 4.6μ apart. The excretory pore is at 0.116 mm. from the anterior end and the nerve ring surrounds the anterior end of the muscular oesophagus at 0.093 mm. from the tip of the head. The head is markedly

separated from the main body and bears two rows of cephalic papillae, the first is circumoral in position and consists of six small papillae. The outer ring has eight submedian papillae and a pair of amphids. The buccal capsule is rectangular in shape, being 19μ long by 6μ wide. The oesophagus is 0.64 mm. long and occupies $^1/_6$th body length. The two components are 0.185 and 0.155 mm. respectively. The tail is 0.180 mm. long, sharply attenuated, ending in a fine pointed tip and is devoid of caudal alae. There are 2 pairs of precloacal and 2 pairs of postcloacal papillae. The cloaca has prominent cuticular lips bearing two pairs of papillae. The first precloacal and the last postcloacal pairs are somewhat ventrally situated. A pair of phasmids is seen at 0.028 mm. from the tip of the tail. The spicules are very unequal measuring 3.08 mm. and 0.097 mm. long, with a length ratio of 31 : 1. The tip of the left spicule is forked and bears a notch at the base of the depression. Both the spicules possess a thin cuticular sheath surrounding their tips.

FEMALE : The females are blood-red in colour when alive. The spirally twisted body is 4.9-5.32 mm. long and 0.405-0.42 mm. wide in maximum width in the middle of the body. The cuticle is thrown into wrinkles and forms wide lateral areas. The flask-shaped buccal capsule is 24μ long and 11μ wide. The nerve ring and the excretory pore is seen at 0.13-0.15 mm. and 0.16-0.18 mm. from the head end. The anterior and the posterior portions of the oesophagus are 0.23-0.25 mm. and 0.60-0.83 mm. long. Its total length occupies $^1/_6$th part of the body. The finally pointed tail is 0.17 mm. long. The vulva is not prominent and is located at 0.27 mm. from the tip of the tail. The muscular vagina runs anteriorly. The eggs are 36μ long and 21μ wide.

Discussion : The worm bears affinities to *M. pusilla*, Travassos, 1915. In the body length and in the presence of adanal papillae they resemble each other, but there are several marked differences which separate the two. There is a single pair of adanal papillae in *M. pusilla* but two pairs in the present worm. The oesophagus occupies $^1/_4$th of the body length in the former and $^1/_6$th in the latter. The length ratio of the spicules is 15 : 1 in *M. pusilla* and 31 : 1 in the worm under discussion.

The above distinguishing features clearly indicate that the worm from the grackle is a new one. It is proposed to name it *M. travassosi* n. sp.

Host : *Gracula religiosa.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Microtetrameres (M.) orioles n. sp.

Numerous males and females were collected on several occasions from

the Golden oriole, *Oriolus oriolus*. The females had to be squeezed out of the Lieberkuehn's glands where they formed cysts, 2.5 mm. large. The bodies are spirally coiled on its longitudinal axis. The males are found in the lumen of the proventriculus.

The cuticle is faintly striated in the male but has marked transverse striations in the females. The cervical papillae are slightly posterior to the nerve ring which surrounds the muscular portion of the oesophagus at 0.12-0.14 mm. from the head end in the male and 0.14-0.16 mm. in the female. The head bears six circumoral, eight suboral papillae and a pair of amphids. The buccal capsule is cylindrical in the male and flask-shaped in the female measuring 16μ long by 8μ wide in the former and 22μ by 11μ in the latter. The oesophagus is 0.45-0.61 mm. and 0.59-0.67 mm. long in the two sexes respectively. The anterior and the posterior portions are 0.152-0.185 mm. and 0.30-0.42 mm. in the male, 0.20-0.23 mm. and 0.39-0.44 mm. in the female.

MALE : The males are very slender and smaller than the females. They range in length from 2.17-3.23 mm. and have a maximum thickness of 0.06-0.08 mm. The cloacal aperture is guarded by prominent lips and is 0.128-0.145 mm. from the tail tip which is papilliform. There are four pairs of caudal papillae of which two are precloacal. The spicules are very unequal in length being 2.03-2.27 mm. and 0.08-0.09 mm. long. The left spicule has a notched tip and is twenty-four times as long as the right. There is a pair of phasmids seen at 0.042 mm. from the tip of the tail.

FEMALE : The females are blood-red when alive. The body is thrice spirally coiled on its long axis. It measures 3.44-4.02 mm. in length and has a maximum diameter of 0.39-0.42 mm. The tail is 0.127-0.130 mm. long and possesses a pair of asymmetrical papillae at 69μ from the tip. The anus has prominent lips. The vulva is 0.22 mm. from the tail end and the muscular vagina runs anteriorly from its opening. The eggs are oval and measure 40-46μ by 25-29μ wide.

Discussion: The present worm bears close resemblance with *M. inermis*. Both the worms are small, with an oesophagus which occupies 1/3rd of the body length and possesses 4 pairs of caudal papillae, yet they differ from each other in certain salient features.

The solitary precloacal papilla present in *M. inermis* is absent in the present worm. The spicule length varies in the two worms, being 1.18 and 75μ in the former and 2.0-2.2 and 85-90μ in the latter. Their length ratio also differs. In *M. inermis* the left is sixteen times as long as the right but twenty-four times in the worm under discussion. The two species also differ

in their other body measurements. It is therefore concluded that the parasite described above constitutes a new species and is named as *M.* (*M.*) *orioles*.

Host : *Oriolus oriolus*.
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Gubernacules n. sub-gen.

Microtetrameres* (*Gubernacules*) *egretes n. sp.

Ten males and twelve females of this species were collected from the proventriculus of the little Egret, *Egretta garzetta*. The thin long worms are of yellowish white colour and were found free in the lumen, whilst the red-coloured spirally twisted females had to be detached carefully from the cysts they had formed in the glands of Lieberkühn.

The males measure 4.05-4.47 mm. long and 0.16-0.18 mm. wide and the females 3.09-3.46 mm. by 0.52-0.68 mm. The cuticle has transverse striations in the male and deep wrinkles in the females. The excretory pore is seen at 0.15-0.17 mm. from the head end in the male and 0.14-0.16 mm. in the female. The nerve ring surrounds the muscular portion of the oesophagus at 0.138-0.145 mm. and 0.130-0.142 mm. from the anterior extremity in the male and the female respectively. The buccal capsule is of uniform diameter (cylindrical) in the male measuring 23μ long by 11μ wide. It is globular in the female and is 24μ by 13μ. The oesophagus occupies $^1/_5$th of the body length and is 0.84-0.86 mm. in the male and 0.76-0.88 mm. in the female. The anterior and posterior portions are 0.22-0.23 mm. and 0.62-0.64 mm. in the male and 0.18-0.24 mm. and 0.58-0.64 mm. in the female.

MALE : The males are very slender and have almost the same body length as that of females. There is a single testis occupying a considerable length of the body. Its proximal end extends into the anterior half of the glandular portion of the oesophagus where it reflexes to run backwards ending in a posteriorly directed tip in the intestinal region. Posteriorly it is followed by a sac-like straight vas deferens. A little distance in front of the cloaca there is a constriction to make the advent of seminal vesicle which is followed by a short ejaculatory duct opening into the cloaca. The spicules are very unequal, the left being 2.78-2.87 mm. and the right 0.13-0.15 mm. long. There is an accessory piece present being 38μ long and 24μ wide. There are two pairs of precloacal and two pairs of postcloacal caudal papillae, asymmetrically arranged. The tail is 0.305-0.332 mm. long and possesses a papilla-like structure at its tip.

FEMALE : The female body possesses wide lateral alae which are very prominent at the posterior extremity. The vulva is near the anal aperture being 0.225 mm. from the tip of the tail, which is sharply pointed and 0.174 mm. long. The vagina runs anteriorly from the vulval opening. The uterus is tightly packed with the eggs measuring 35μ long and 15μ wide.

Discussion : The parasite differs from all the known species of Microtetrameres in possessing an accessory piece. Sulmanov, 1945, reported *M. gubernaculiferens* from bald marsh kite without description, hence cannot be compared with it and is regarded as a new species of the subgenus *gubernacules*.

Host : *Egretta garzetta.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Microtetrameres* (*Gubrenacules*) *mirzai n. sp.

The material available for study consisted of three males and two females, once collected from the Lieberckühn's glands of the proventriculus of Himalayan Kestrel, *Cerchneis tinnunculus interstinctus*. The males are filiform and the females fusiform and spirally twisted. The former being white and the latter bloodred in colour when alive.

MALE : The length of the body ranges from 2.1-2.5 mm. with a maximum width of 0.15-0.17 mm. The cuticle is thin, transparent and is transversely striated. The mouth is surrounded by two concentric rows of papillae the inner having 6 and the outer 8. There is a pair of laterally situated amphids present in the outer circle. The buccal capsule is cylindrical in shape 21-23μ long by 8-10μ wide. It leads into the muscular portion of the oesophagus which is 0.194-0.225 mm. long. The glandular portion is 0.55-0.57 mm. in length. The entire oesophagus occupies $^1/_3$rd of the body length.

The tail is 0.14-0.18 mm. long and sharply pointed. The tip is button-shaped which is seen protruding out of the main body. There are two pairs of precloacal and two pairs of postcloacal papillae. A pair of phasmids is seen at 33 from the tail end. The spicules are very unequal being 1.13-1.30 mm. and 0.08-0.09 mm. long. The right spicule is smaller and is acicular while the left has a forked tip. The gubernaculum is fairly chitinized measuring 28μ, both the arms being almost of the same length. It is as wide as long.

FEMALE : The female is thrice spirally coiled on its long axis measuring 3.61-4.01 mm. in length and 0.45-0.49 mm. in maximum diameter. The cuticle is very much wrinkled. The head and the tail ends are sharply

attenuated. The buccal capsule is 26-28μ long and 9-10μ wide. The nerve ring and the excretory pore are located at 0.116 mm. and 0.121 mm. respectively. The oesophagus is 1.08 mm. long and the two respective portions are 0.24 mm. and 0.84 mm. in length. The intestine is sac-like and full of black detritus. The tail is 0.16 mm. long. The vulva is at 0.27 mm. from the posterior extremity. The uteri are tightly packed with the embryonated eggs 48μ long and 28μ wide.

Discussion: The worm agrees with the earlier described species in this paper, in possessing a gubernaculum, 4 pairs of caudal papillae and a terminal button on the tail of the male.

It differs from *M.* (*G.*) *egretes* in possessing symmetrical caudal papillae, smaller tail, gubernaculum with almost equal arms and the left spicule with a forked tip. Moreover, the spicule ratio in *M.* (*G.*) *egretes* is 20 : 1 but 14 : 1 in the present worm. The oesophagus of the former is $^1/_5$th of the total body length whilst it is $^1/_3$rd in the latter. However, the main difference lies in the length of the body which is only half as that of *M.* (*G.*) *egretes.*

Taking into account the above distinguishing characters, it is regarded as a new species. It is proposed to name it *M.* (*G.*) *mirzai* after Professor M. B. Mirza.

Host : *Cerchneis tinnunculus interstinctus.*
Habitat : Proventriculus.
Locality : Hyderabad-Deccan (India).

Microtetrameres* (*Gubernacules*) *osmaniae n. sp.

The examination of the proventriculus of the Asiatic sparrow hawk *Accipiter nisus nisosimilis* revealed the presence of three pairs of worms belonging to the family Tetrameridae. The males are yellowish and the females orange-red in colour.

MALE : The males are very small and slender. The body length ranges from 1.87-2.75 mm. and the diameter is from 0.135 mm. to 0.150 mm. The cuticle is thin and striated, the striae being 5.8μ apart in the middle of the body. The nerve ring is 0.117-0.12 mm. from the anterior end. The excretory pore opens at a distance of 0.120-0.140 mm. from the tip of the head. The mouth is surrounded by two rows of cephalic papillae ; six circumoral, 8 submedian and a pair of laterally situated amphids. The buccal capsule is cylindrical measuring 17-19μ long by 6-9μ wide. The oesophagus is 0.76-1.23 mm. long occupying almost half of the body. The two parts are 0.12-0.22 mm. and 0.63-1.0 mm. long.

The tail is sharply attenuated, 0.10-0.12 mm. long, possessing a papilla at its tip. There are two pairs of preanal and two pairs of postanal papillae. The two spicules are feebly chitinized measuring 1.15-1.22 mm. and 0.05-0.08 mm. long, both have acicular tips. There is a small gubernaculum, 28μ long by 13μ in maximum width. The cloacal aperture is guarded by two prominent lips.

Female : The females are 2.16-2.52 mm. long and 0.437-0.50 mm. in maximum thickness. The excretory pore and the nerve ring are seen at 0.130 mm. and 0.120 mm. from the anterior end. The buccal capsule is 18-20μ long and 11-13μ wide. The muscular and the glandular portions of the oesophagus are 0.19-0.22 mm. and 0 78-0.99 mm. long respectively. The two together occupy half of the body length. The vulva is close to the anal aperture being 0.16-0.18 mm. from the tip of the tail which measures 0.12-0 14 mm. in length. The uterus is tightly packed with the eggs which are embryonated and measure 44-48μ in length by 24-26μ in maximum diameter.

Discussion : This species can readily be distinguished from *M.* (*G.*) *egretes* in the following features : *M.* (*G.*) *egretes* is twice as long as the present worm. The length ratio of the spicules of the worm under discussion is 15 : 1 whereas it is 20 : 1 in *M.* (*G.*) *egretes.* Moreover the tail of the latter is three times as long as *M.* (*G.*) *osmaniae.*

The eggs of the present worm are almost double in size than those of *M.* (*G.*) *egretes.* It also differs in various body measurements.

M. (*G.*) *mirzai* comes closer to this worm where the length of the worm is taken into consideration, but differs from it in possessing an oesophagus running up to $^1/_3$rd the length of the body whereas it occupies half of the body length in the present worm. The lengths of the short spicule, tail and the gubernaculum also differ in the two worms. The female of *M.* (*G.*) *mirzai* is one and a half times as long as the present worm. The distance of vulva from the tip also varies in the two being 0.278 mm. in *M.* (*G.*) *mirzai* and 0.16-0.18 mm. in the worm under discussion.

In view of these differences it is regarded as a new species naming it after the Osmania University, Hyderabad-Deccan, as *M.* (*G.*) *osmaniae* n. sp.

Host : *Accipiter nisus nisosimilis.*

Habitat : Proventriculus.

Locality : Hyderabad-Deccan (India).

Key to the Subgenera of the Genus *Microtetrameres* Travassos 1915*b*.

Gubernaculum present	... *Gubernacules* n. sub. gen.
Gubernaculum absent	... *Microtetrameres* Travassos, 1915.

Key to the species of subgenus *Gubernacules*.

Males 4 or more than 4 mm. long ; Oesophagus $^1/_5$th of the body length, Spicule ratio 1 : 20. Male tail 0.305-0.322 mm. long.	*M.* (*G.*) *egretes* n. sp.
Males less than 4 mm. long, Male tail short ...	1
1. Females 2.1-2.5 mm. ; oesophagus half the body length, spicules ratio 1 : 15, left spicule with pointed tip.	*M.* (*G.*) *osmaniae* n. sp.
Females 3.6-4 mm. ; oesophagus $^1/_3$rd of the body length, spicule ratio 1 : 14, left spicule forked at the tip.	*M.* (*G.*) *mirzai* n. sp.

Subgenus *Microtetrameres* Travassos, 1915

Male 6 mm., spicule ratio 1 : 36 ...	*M.* (*M.*) *contorta* (Weidman, 1913) Travassos, 1915*b*.
Males less than 6 mm. ...	1
1. Three pairs of preanal papillae, 4 pairs of postanal, one pair of dorsolateral.	*M.* (*M.*) *canadensis* Mawson, 1956.
Two pairs of preanal papillae ...	2
One pair of preanal papillae, Male 1.17-1.4 mm., Female 2 mm. long, spicule ratio 8 : 1 (L. S. 0.651-0.787 mm., R. S. 0.082 mm.)	*M.* (*M.*) *cruzi* (Travassos, 1914) Travassos, 1915*b*.
2. Adanal papillae present ...	3
Adanal papillae absent ...	4
3. One pair of adanals, Males 3.5-4 mm., Females 2 mm. long, spicule ratio 15: 1 (L. S. 1.32 mm. R. S. 0.085 mm.) oesophagus $^1/_4$th body length (Male).	*M.* (*M.*) *pusilla* Travassos, 1915*b*.
Two pairs of adanal papillae, Male 4.9-5.3 mm., spicule ratio 31 : 1 (L. S. 3.02 mm., R. S. 0.0-9 7mm.) oesophagus $^1/_6$th body length (Male).	*M.* (*M.*) *travassosi* n. sp.
4. Left spicule nine times as long as the right or less.	5
Left spicule more than nine times as long as the right.	7

5. Male 1.4 mm., long, Female 0.780 mm. long, spicule ratio 9 : 1 (L. S. 0.990 mm., R. S. 0.10 mm.)	*M.* (*M.*) *minima* (Travassos, 1914) Travassos, 1915*b*.
Males more than 3 mm. long ...	6
6. Two pairs of preanal, 3 pairs of postanal papillae, constriction between vas deferens and testis 0.50-0.56 mm. anterior to cloaca.	*M.* (*M.*) *bubo* Schell, 1953.
Two pairs of preanal, 2 pairs of postanal constriction between vas deferens and testis 0.80-0.94 mm. anterior to cloaca.	*M.* (*M.*) *aquila* Schell, 1953.
7. Oesophageal or intestinal diverticulum present...	8
Oesophageal or intestinal diverticulum absent or not otherwise described.	9
8. Spicule ratio 20 : 1 (L. S. 2.03-2.4 mm. R. S. 0.10-0.15 mm.), cuticle of female 'forming a ruffled longitudinal flange'.	*M.* (*M.*) *accipiter* Schell, 1953.
Spicule ratio 26 : 1 (L. S. 3.2-3.8 mm. R. S. 0.120-0.140 mm.), cuticle of female not with longitudinal flange.	*M.* (*M.*) *corax* Schell, 1953.
9. Males more than 4 mm. long ...	10
Males less than 4 mm. long ...	11
10. Spicule ratio 16 : 1 (L. S. 2.3 mm., R. S. 0.145 mm.), oesophagus $^1/_3$rd body length.	*M.* (*M.*) *spiralis* (Seurat, 1915) Travassos, 1915*b*.
Spicule ratio 27 : 1 (L. S. 3.6 mm., R. S. 0.136 mm.) oesophagus $^1/_6$th of body length.	*M.* (*M.*) *helix* Cram, 1927.
11. Left spicule sixteen times as long as the right (L. S. 1.187 mm., R. S. 0.075 mm.) oesophagus $^1/_3$rd of the body length.	*M.* (*M.*) *inermis* (Linstow, 1879) Travassos, 1915*b*.
Left spicule longer than the above ...	12
12. Female 1.2 mm. long, spicule ratio 22-20 : 1 (L. S. 2.312-2.576 mm., R. S. 0.103-0.147 mm.) oesophagus $^1/_4$th of the body length.	*M.* (*M.*) *spiculata* Boyd, 1956.
Female 3.44-4.0 mm. long, spicule ratio 24 : 1 (L. S. 2.03-2.2 mm., R. S. 0.08-0.09 mm.) oesophagus $^1/_3$rd of the body length.	*M.* (*M.*) *oreoles* n. sp.

Tetrameridae : Travassos, 1914.

GEOPETITINAE : Chabaud, 1951.

Geopetitia : Chabaud, 1951.

Geopetitia chabaudi n. sp.

On two occasions three pairs of this species and several fragments were collected from the large jungle Babbler, *Turdoides terricolor*. The examination of the Indian Magpie Robin, *Copsychus saularis saularis* also revealed the presence of these worms. The parasites were found intricately rolled in the nodules formed on the outer wall of the proventriculus. The worms had to be detached with greatest care and extreme difficulty from their cysts, so that they may not break into pieces.

The worms with a long body and thin transparent cuticle apparently look like filarids. The cuticle bears fine transverse striations, the striae being set at intervals of 17-19μ. The body is almost cylindrical except at the extremities. The anterior end is sharply marked off just at the tip, by a conically pointed head ; the posterior extremity is a characteristic feature of this genus. In the male a little distance behind the posterior third, the body abruptly narrows into a whip-like peduncle which swells to form a long almost rectangular expanded portion with a maximum width of 0.13-0.17 mm. which narrows again to end in a short bluntly pointed tip. The expanded portion has wide lateral fields divided into cuticular folds. In the females the expanded portion is very well marked off and is divided into a larger anterior and a smaller posterior portion by a constriction in which the vulva is located, the two having a maximum diameter of 0.30-0.44 mm. and 0.165-0.193 mm. respectively. The conically pointed head has a dorsoventral diameter of 59μ and 61μ in the male and the female respectively. The mouth is surrounded by two prominent lateral tips each of which is trilobed, the lateral lobe being very conspicuous, having a height of 18-20μ. The two sublateral pairs are horizontal in position, each of which bears a papilla. There is a transparent cuticular band connecting the bases of the lips on which is found a pair of submedian and a pair of sublateral papillae. The amphids are laterally situated. The papillae can be seen to advantage in the enface view (fig. 62). The excretory pore opens at 0.21 mm. from the head end in the male and 0.23 mm. in the female. The nerve ring is seen surrounding the muscular portion of the oesophagus at 0.12-0.14 mm. and 0.16-0.18 mm. in the male and the female respectively. The cervical papillae could not be detected even after prolonged search.

The mouth opens into a much reduced buccal capsule measuring up to 18-19μ by 8-9μ in the male and 20-22μ by 9-10μ in the female. The oeso-

phagus is divided into muscular and glandular portions measuring 0.162-0.20 mm. and 0.56-0.78 mm. long in the male and 0.31-0.36 mm. and 0.96-1.1 mm. in the female respectively. The entire oesophagus being 0.62-0.98 mm. and 1.2-1.46 mm. long covering $^1/_{26}$th and $^1/_{33}$rd of the total body length in the two respective sexes.

MALE : The males are distinctly smaller than the females being a little less than $^1/_3$rd as long as the latter. They measure 18-27 mm. in the length and 0.43-0.46 mm. in maximum width. The single filiform testis lying in the middle of the body extends up to a little distance behind the junction of the oesophagus and the intestine where it recurves to end in a posteriorly directed tip. The cloaca is at 0.18-0.23 mm. from the tip of the tail. The posterior extremity is strongly flexed ventrally and is devoid of alae but surrounding the cloacal aperture is a thin circumcloacal cuticular expansion. There are altogether six pairs of caudal papillae of which two are preanal and four postanal in position. Besides these there is present a pair of phasmids at a distance of 0.039 mm. from the finger-like tip of the tail which is 0.019 mm. long. The spicules are almost equal measuring 0.16 and 0.15 mm. The two spicules though of the same length, differ in their thickness. The stouter spicule possesses a transparent ala enveloping its tip.

FEMALE : The females are 43-49 mm. in length and 0.92-0.96 mm. in maximum diameter. The two ovaries are situated in the first and the last quarters of the body and after a convoluted course open into a bulb-shaped seminal receptacle which in turn is continuous with the uterus. The anterior seminal receptacle is in the anterior half of the glandular portion of the oesophagus. The uterus has a cone-shaped protrusion anteriorly. The vulva opens in a depression between the two expansions of the caudal end, 0.32-0.43 mm. from tip of the tail. The vagina is long bending itself and curving anteriorly to join the two limbs of the uterus. There is a pair of papillae situated at 0.060-0.064 mm. from posterior extremity. The tail measures 0.127-0.183 mm. The thick-shelled embryonated eggs are 44-52μ in length by 22-32μ in maximum width.

Discussion: The genus *Geopetitia* was established by Chabaud in 1951, the genotype being *G. pari* from *Parus ater*. He has most convincingly discussed the relationship of this worm with *Microte rameres* and has also erected a sub-family Geopetitinae under the family Tetrameridae. The writer would like to draw the attention to one more characteristic feature, the circumcloacal alae which are also present in *Microtetrameres* described by the writer in this paper. There seems to be a gradual increase in the size of the cuticle forming the 'lips' of the cloaca, which fuse together and ultimately develop into circumcloacal ala. Thus the relationship between the

two genera is further established. A characteristic regarded by Chabaud as a factor of affinity between *Tetrameres, Microtetrameres* and *Geopetitia* is the absence of gubernaculum in the three genera, but this structure is reported to be present in the first two groups, hence the writer recommends its deletion as a factor of relationship.

The present worm differs from the genotype in possessing four pairs of postanal caudal papillae as against five pairs, and in the absence of the adanal papillae. In the presence of a pair of papillae on the female tail, it also differs from *G. pari.* The length of the fragments of female is given as 53 mm., as against this the female of the present worm ranges from 43-49 mm. Taking into account the various differences existing between the two worms, the present parasite is regarded as a new species. It is named as *G. chabaudi* n. sp. after A. G. Chabaud.

Hosts : 1. *Turdoides terricolor.*
2. *Copsychus saularis saularis.*

Habitat : Outer wall of the proventriculus.
Locality : Hyderabad-Deccan (India).

The type specimens of the species described in this part are deposited in Zoology Department, Osmania University.

SUMMARY

1. Four new species of the genus *Oxyspirura* are described and a key to the species of the genus is prepared. *O.* (*O.*) *peipingensis* is a new record for India from a new host.
2. An account of four new species of *Tetrameres* is given and *Tetrameres* (*Gynaecophila*) *ardea* is reported for the first time from India. A key to the known species of the genus is provided.
3. Five new species of *Microtetrameres* are recorded and the genus is divided into two subgenera *Microtetrameres* and *Gubernacules* n. sub. gen. A key to the species of the subgenera is given.
4. A new species of *Geopetitia* is reported from *Turdoides terricolor* and *Copsychus saularis.*

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PART III

Dipetalonematidae Wehr, 1935.

ONCHOCERCINAE Lieper, 1911.

Singhfilaria n. g.

S. pavonica n. sp.

The material for study consists of three males and two females collected from under the skin of the neck of the common peafowl *Pavo cristatus*. Both the sexes when freshly collected are milky white in colour.

These are medium-sized worms having cylindrical bodies with rounded ends. The males measure 7.5-16 mm. in length and 0.20-0.28 mm. in maximum width, the females 25-51 mm. and 0.30-0.36 mm. respectively. The dorsoventral diameter of the head is 0.088-0.092 mm. and 0.121-0.124 mm. in the two respective sexes. The cuticle is 27μ thick in the male and 55μ in the female bearing very fine close set transverse striations. In addition to these, there are present fusiform thickenings distributed irregularly covering the entire body surface. In the lateral fields they appear like bosses, but in the dorsal and ventral surfaces their fusiform shape is prominently displayed. The head is somewhat knob-like and bears four pairs of cephalic papillae and a pair of laterally situated amphids. The nerve ring surrounds the oesophagus not far off from the head end, at 0.099-0.104 mm. in the male and 0.105-0.107 mm. in the female. The excretory pore opens at 0.100-0.105 mm. and 0.108-0.200 mm. from the head end in the two sexes respectively. The mouth is terminal and opens directly into the muscular portion of the oesophagus which is very short measuring 0.139-0.142 mm. and 0.20-0.25 mm. in the two sexes and a much broader glandular portion 1.72-2.43 mm. long in male and 3.8-4.7 mm. in the female.

MALE : The males are smaller and thinner than the females being a little less than $^1/_3$rd of the latter. The tail is very short measuring 16-20μ, the cloacal aperture being subterminal. There are only two pairs of fairly prominent papillae, one just in front and the other immediately posterior to the cloaca. The spicules are unequal and dissimilar, the right 0.113-0.116 mm. and the left 0.240-0.276 mm. long. The latter possesses an expanded head and a body with narrow anterior region and broader posterior portion showing a twist at about half of its length. The tip possesses a pair of bifurcated and diversely directed chitinous projections. The body of the right spicule is divided into a longer and broader anterior portion and a

narrower and shorter posterior region with a kink which separates the two parts. The left is more than twice the length of the right spicule.

FEMALE : The females are fairly long being more than twice as long as the males. The tail is very short having a length of 15-19μ with a small conically projected tip. The vulva is oesophageal in position and is flush with the body surface opening at 0.47-0.54 mm. from the head end. The vagina runs posteriorly for a short distance, then turns forwards and recurves again to pursue a backward course. The limbs of the uterus are very much convoluted and fill up all the available space in the body. The microfilaria measure 91-100μ long by 5-8μ in maximum width.

Discussion : The sub-family *Onchocercinae* was erected by Leiper in 1911 on the basis of the cuticular structures (rugae, deep annulations and fusiform bosses) present on the body in addition to fine striae. Wehr (1935) suppressed the sub-family on the grounds that the cuticular structures are not to be relied upon as a criterion of generic importance. Moreover, the presence of bosses and thickenings of the cuticle is neither confined to the Onchocercinae nor do all the species of *Onchocerca* possess these structures. Hence he erected a new family *Dipetalonematidae* which included two sub-families *Dirofilarinae* and *Dipetalonematinae*. The latter sub-family accommodated *Onchocerca* Diesing, 1941, *Onchocercella* Yorke and Maplestone, 1931 and *Eleaophora* Railliet and Henry, 1912 of the original Onchocercinae along with some other genera. In the following year, Skrjabin and Schikobalova (1936) also suggested that the Onchocercinae may prove to be an artificial group. Chabaud and Choquet, 1953, accepted Dipetalonematidae and assigned to it four sub-families, Cardionematinae, Yamaguti, 1941, Oswaldofilarinae Chabaud and Choquet, 1953, Splendidofilarinae Chabaud and Choquet, 1953 and Onchocercinae Leiper, 1911. Of these four sub-families the last two are very closely related and differentiated on the lengths of the tail and the spicules. The former possessing 'Queue longue ou courte et spicules egaux ou peu differents l'un de l'autre' and the latter having 'Queue courte, et spicules tres differents l'un de l'autre.' Although Onchocercinae is revived, the genera it originally contained (Peters, 1936) are split up between the two allied sub-families ; *Par-onchocera*, Peters, 1936, *Eleaophora* Railliet and Henry, 1912 and *Onchocerca* Diesing, 1941, are retained in Onchocercinae but *Onchocercella* is transferred to Splendidofilarinae.

The present worms could not be placed in Splendidofilarinae because of its subterminal anus and unequal and dissimilar spicules. In Onchocercinae, it comes closer to *Paronchocerca* which also represents the parasites of birds. The shapes of the spicules bears close resemblance in the two groups. The length ratio between the two spicules is almost 2 : 1 in both. The

shorter anterior and longer and broader posterior oesophegus is found in both the genera. Though the two worms resemble each other in so many characteristics, yet they differ considerably. In having four pairs of submedian cephalic papillae in two concentric rows as against two pairs in *Paronchocerca*, in possessing transverse fusiform thickenings which are absent in the latter, in having subterminal cloaca and anus, and in the absence of anogenital papillae the present worm differs also from *Paronchocerca*.

In possessing cuticle with fine transverse striations in both the sexes and with fusiform thickenings distributed irregularly between them and in having a short muscular anterior and broader and longer posterior oesophagus, the present worm comes closer to *Onchocercella* Yorke and Mapleston, 1931. The worm also possesses four pairs of cephalic papillae in two concentric rows in which respect it resembles *Onchocerca*. Both the genera are parasitic in the intramuscular connective tissues of mammals whereas the present worm is parasitic under the skin of the neck of a peacock. Moreover, it differs from both of them in various salient characteristics which make its accommodation in *Onchocercella* improbable. There are four pairs of submedian cephalic papillae arranged in two concentric rows in the present worm as against two pairs in *Onchocercella*. There are six adanal pairs and a pair of subterminal papillae in the latter whereas just two pairs, one precloacal and one postcloacal papillae are present in the former. The spicules are subequal in *Onchocercella* but unequal in the above described worm. The tail in both the sexes of *Onchocercella* is fairly long but it is very short in the present worm which has subterminal cloaca and anus in the two sexes.

Taking into consideration the above-mentioned characteristics, the writer regards the present parasite as representing a new genus. It is proposed to name it *Singhfilaria* after Professor S. N. Singh.

Generic Diagnosis : Onchocercinae : body filiform, mouth devoid of lips, surrounded by eight submedian papillae, cuticle in both the sexes bearing fine transvere striae with fusiform thickenings distributed irregularly between them. Oesophagus divided into a very short, narrow anterior portion and a longer and wider posterior region. Caudal alae absent. Anogenital papillae two pairs, spicules unequal and dissimilar, cloaca subterminal. Vulva in the oesophageal region. Microfilaria thin, long without a sheath. Anus sub. terminal, parasites under the skin of the neck of the birds.

Genotype : *Singhfilaria pavonica.*

Host : *Pavo cristatus.*

Locality : Hyderabad-Deccan (India).

Dipetalonematidae Wehr, 1935.

SPLENDIDOFILARINAE Chabaud and Choquet, 1953.

Chandlerella Yorke and Maplestone, 1926.

Chandlerella thapari n. sp.

The specimens of this species were collected from the peritoneal cavity of the Indian Bush Chat, *Saxicola torquata indica*.

These are very slender worms with attenuated extremities. The cuticle is thin, smooth and devoid of transverse striations. The excretory pore opens at 0.116 mm. from the head end in the male and 0.163 mm. in the female. The nerve ring surrounds the oesophagus slightly anterior to the junction of its muscular and glandular portions, at a distance of 0.095 mm. from the anterior end in the male and 0.115 mm. in the female. The cervical papillae could not be observed. The mouth is simple and devoid of lips but is surrounded by two pairs of small submedian cephalic papillae and a pair of laterally situated amphids. It opens into the oesophagus which is 0.509 mm. and 0.604 mm. long occupying about $^1/_{12}$th and $^1/_{14}$th part of the body in the two respective sexes. It is divided into a muscular and a glandular portion measuring 0.11 mm. and 0.399 mm. in the male, 0.127 mm. and 0.477 mm. in the female, the glandular portion being much broader and about three times longer than the muscular. The anus is atrophied and the hind end of the intestine terminates blindly. There is a slight depression indicating the position of the anus.

MALE : The male is 6 mm. in length by 0.102 mm. in maximum width and is not markedly shorter than the female. The maximum transverse diameter of the body is 0.10 mm. The tail is digitiform and ventrally curved. The caudal alae and the preanal papillae are lacking but three pairs of postanals are present. The first postanal is at 0.062 mm. from the cloaca. The last pair is just in front of the tip of the tail while the second pair is equidistant from both of them. The spicules are subequal and fairly chitinized. They measure 0.072 mm. and 0.060 mm. in length. Both the spicules have truncated tips and the heads marked off by a slight constriction from the rest of the body. The cloacal aperture lies at 0.153 mm. from the tip of the tail.

FEMALE : The female is 8.5 mm. long with a maximum transverse diameter of 0.399 mm. The tail is blunt and measures 0.184 mm. The vulva opens at the level of the anterior and middle third of the glandular portion of the oesophagus at a distance of 0.26 mm. from the head end. It leads into a posteriorly directed vagina which is connected with the common trunk of the uterus.

Discussion : The genus was established by Yorke and Maplestone, 1926, for Chandler's worm *Filaria bosei* from *Dissemurus paradiseus*. In 1929, Pandit, Menon and Iyer reported this worm from a 'crow' in Madras. Li, 1933, described the second species of this genus as *C. sinensis*. Singh, 1948, expressed his doubt about the validity of the genus basing the arguments on the possible presence of bosses on the cuticle of the live worms and their disappearance in the preserved condition and hence regarded it as a synonym of *Splendidofilaria*. Chabaud et Choquet accepted his contention. Ali in 1956, reported *C. sinensis* from *Corvus macrorhynchus* and described another new species *C. singhi* from the heart of common Night Jar, *Caprimulgus asiaticus*. None of the writers who reported *Chandlerella* has described bosses on the cuticle of the worm. The present writer had an opportunity of examining the worms both in the living and the preserved conditions but failed to observe the said bosses even under higher magnification. It is highly improbable that all of them have missed this structure. Moreover, *Chandlerella* has certain characteristics of its own which distinguish it from *Splendidofilaria* and other parasites of heart. The constant absence of the preanal papillae, the trough-shaped strout spicules, the absence of bosses on the cuticle and the divided oesophagus are characteristics sufficient enough to seperate it from *Splendidofilaria*. The latter has a narrow, undivided tubular oesophagus whereas the oesophagus of *Chandlerella* is divided into muscular and glandullar portions. Yorke and Maplestone described the oesophagus as 'stout, short and not divided into two parts.' Excepting these authors, all the others have reported the oesophagus as stout, but divided into two parts. Hence the latter statement is to be accepted. In the writer's opinion the structure of the oesophagus should be given more importance than the presence or absence of bosses in the separation of the two genera. The structure and the shape of the spicules in the two groups also differ. In *Splendidofilaria* they are described as 'short, subequal and finely pointed', but *Chandlerella* has stout, trough-shaped spicules with truncated, dentigerous or notched tips. The number of the caudal papillae also differs in the two. *Splendidofilaria* possesses five to eight pairs of caudal papillae whereas in *Chandlerella* the preanal papillae are altogether absent and three to four pairs of postanals are observed. The tail ends of the females also differ markedly. In the former it is bluntly pointed while the latter has a short and rounded tail. Thus the amalgamation of the two groups is not justifiable.

The present parasite differs from all the known species of *Chandlerella* in being the smallest. The proportion of the oesophagus to the body and the length of the spicules also vary from all the other worms. Hence it is

regarded as a new species and named after Professor G. S. Thapar.

Host : *Saxicola torquata indica.*

Habitat : Peritoneal cavity.

Locality : Hyderabad-Deccan (India).

Chandlerella columbigallinae (Augustine, 1937) n. comb.

Numerous specimens of this parasite were collected from the southern green pigeon, *Crocopus phaenicopterus*. The worms were found creeping on the peritoneum.

These are rather thin worms, with cylindrical bodies tapering slightly and terminating in rounded extremities. The cuticle is smooth, without transverse striations and devoid of bosses. The head carries two pairs of submedian and a single pair of lateral amphids. There is no buccal capsule and the mouth opens directly into the oesophagus. The nerve ring surrounds the oesophagus at a distance of 0.10-0.12 mm. from the anterior end in the male and 0.13-0.15 mm. in the female. The excretory pore open at 0.150-0.155 mm. and 0.167-0.170 mm. from head end in the two sexes respectively.

Male : The males are more slender and smaller than the females. They measure 14.5-16.15 mm. in length and 0.19-0.21 mm. in maximum width. The oesophagus is inconspicuously divided into two parts occupying $^1/_{24}$th part of the body. The anterior and the posterior portions are of the same diameter except that the posterior end of the glandular oesophagus is somewhat swollen. The two portions measure 0.138-0.16 and 0.465-0.510 mm. respectively.

The digitiform tail is devoid of caudal alae and is ventrally twisted. The cloacal aperture is 0.174-0.178 mm. from the tip of the tail. There are altogether four pairs of postanal papillae, the preanals being absent. The spicules are more or less similar: short, subequal and fairly chitinized, measuring 0.059-0.062 mm. and 0.068-0.070 mm. in length with rectangular heads, trough-shaped bodies and truncated tips.

Female : The females are one and a half times as long as the males, imasuring 21.5-24.8 mm. in length and 0.37-0.40 mm. in maximum width. The two portions of the oesophagus have almost the same width and measure 0.170-0.210 mm. and 0.521-0.613 mm. in length respectively. The vulva is at 0.446-0.466 mm. from the head end. The muscular vagina pursues a backward course receiving the uterus the branches of which run parallel to each other. The uteri are full of microfilaria measuring 0.112-0.118 mm. long by 3-6μ wide. The tail is bluntly rounded measuring 0.26-0.29 mm. in length. The anus is atrophied being represented only by a depression.

Discussion : Augustine established the genus *Vagrifilaria* in 1937 the type species being *V. columbigallinae*. Johnston and Mawson (1942) reported a parasite as '*V. australis*' from *Centropus phasianus*. This worm differs from the genotype in several respects and after a careful study one can hardly accept *V. australis* as a species of the genus *Vagrifilaria*. The figures drawn by Johnston and Mawson leave no doubt regarding the parasite being *Lissonema* rather than *Vagrifilaria*. There is some discrepancy in the description and the figures drawn. There are 'two large and three small papillae on each side, the small ones more anteriorly situated than the large', but the figure shows that there are six pairs of cephalic papillae of which 4 are large and 8 small. The arrangement of these papillae is exactly the same as that of *L. rotundatum* described in the present paper (figs. 37 and 38). Moreover, the structure of oesophagus, shape of the spicules, the disposition of the caudal papillae, the length and form of the tail resemble very much the genotype of *Lissonema*. Hence it should be regarded as *L. rotundatum* rather than a species of *Vagrifilaria*.

	V. columbigallinae Augustine, 1937	*V. australis* Johnston and Mawson, 1942	*Lissonema rotundatum* Linstow, 1903, Boulenger 1928
Body length Male ...	13	25	23
Female ...	20-23	40-45	40
Oesophagus Male ...	0.750-0.800	7.0	5.0
Female ...	1.0	6.90	6.2
Vulva ...	About the middle of the posterior portion of the oesophagus.	0.9	1.0
Spicules ...	0.070-0.080	0.25	0.19 and 0.20
Caudal papillae in Male.	No preanals 4 pairs of postanals.	2 pairs of preanal 3 pairs of postanal 1 terminal.	One median preanal 3 pairs of postanal
Host ...	*Columbigallina passerina nigrirostis*	*Centropus phasianus*	*Centropus sinensis*

Table showing the similarities between *V. australis* and *Lissonema rotundatum*. All measurements in millimeters.

Most probably it was this reason which led Chabaud and Choquet (1953) to separate the two species of *Vagrifilaria*, *V. columbigallinae* and *V. australis* and allot them to *Splendidofilaria* and *Paramicipsella* respectively, *Vagrifilaria* cannot be regarded as a synonym of *Paramicipsella* as the latter is oviparous whereas the former is viviparous. Moreover, the tail is very

short in *Paramicipsella* while it is quite long in *Vagrifilaria*. The bosses are lacking in the latter which are so characteristically present in the former.

Though the genus *Vagrifilaria* resembles *Splendidofilaria* in having a long tail, it can easily be separated from it by the absence of bosses and in possessing a very thin, undivided oesophagus as against a broad, divided oesophagus of *Vagrifilaria*.

Augustine while establishing the genus *Vagrifilaria* did not discuss its affinities with *Chandlerella* which seems to be identical with it in several respects. In both, the oesophagus is divided into two portions which are not well marked off. The shape of the spicules, the form of the tail, the disposition of the caudal papillae, the presence of the tip of the ovary in the tail region and in the viviparity both the 'genera' come so close together that it hardly justifies their separation. The only character in which they differ is the number of caudal papillae (3 and 4), which is to be regarded as a specific characteristic rather than generic.

Thus in the writer's opinion *Vagrifilaria* should be regarded as a synonym of *Chandlerella* and not of *Splendidofilaria* or *Paramicipsella*. The present worm resembles *C. columbigallinae* (n. comb.) in the length of the body, oesophagus, spicules, tail and the position of the vulva. Hence it is regarded as the same species. Here it is recorded for the first time from a new host *Crocopus phaenicopterus*.

Host : *Crocopus phaenicopterus* (Southern green pigeon).
Habitat : Peritoneal cavity.
Locality : Hyderabad-Deccan (India).

Dipetalonematidae Wehr, 1935.
SPLENDIDOFILARINAE Chabaud and Choquet, 1953.
Paraprocta Maplestone, 1931.

Paraprocta brevicauda (Chandler, 1924) Maplestone, 1931.

A solitary male worm of this species was collected once from the body cavity of the Indian Hoopoe, *Upupa epops orientalis*. This species was first reported by Chandler (1924) as *Fliaria brevicauda* and then by Maplestone by the present name. There are slight differences between the descriptions of the two writers and as it is collected from a new host, it is thought advisable to redescribe it.

This is a small worm, having a cylindrical body with bluntly rounded extremities. It has a total body length of 7.6 mm. and is 0.193 mm. in maximum diameter. The dorsoventral diameter of the head is 72μ. The cuticle is thin and devoid of transverse striations, but there are present

longitudinal striae running all along the length of the body. The head bears two pairs of small papillae seen only under high magnification. The nerve ring surrounds the anterior portion of the oesophagus at 0.156 mm. from the head end, a little distance behind this is situated the excretory pore opening at 0.196 mm. from the anterior extremity. The mouth opens directly into the oesophagus which is not divided into a muscular and glandular portions and measures 0.485 mm. in length.

The tail is short, ventrally curved, measuring 0.058 mm. and is devoid of papillae. The cloacal aperture is situated on a slight prominence. The spicules are unequal, the longer being almost double the length of the shorter, the two measure 0.099 mm. and 0.59 mm. respectively. The tips of the spicules are seen partially extruded out of the cloacal aperture. Both are fairly chitinized having expanded heads and trough-shaped bodies. The tip of the larger spicule is pointed but the other spicule has a somewhat rounded end.

The parasite is reported from several hosts dying in the Zoological Garden, Calcutta. Maplestone suggests that 'the infection is acquired in the Zoo, where numerous species of birds, confined in close proximity to one another, would be easily attacked by an insect vector', but its presence in a new host indicates the wide spread distribution of the worm under natural conditions.

Host : *Upupa epops orientalis.*
Habitat : Body cavity.
Locality : Hyderabad-Deccan (India).

Dipetalonematidae Wehr, 1935.
SPLENDIDOFILARIINAE Chabaud and Choquet, 1953.
Eufilaria Seurat, 1921.

Eufilaria buckleyi n. sp.

One male and a single female of this species were recovered once from the body cavity of the common Nightjar, *Caprimulgus asiaticus.*

These are thin worms having little difference in the size. The body is straight and of uniform thickness with rounded extremities. The cuticle is thin having very fine transverse striations seen only under high magnification. The head bears two pairs of submedian and a single pair of lateral papillae. The mouth is devoid of lips and opens directly into a thin narrow oesophagus. The excretory pore and the nerve ring are situated at 0.30 and 0.20 mm. respectively from the head end in the male and 0.31 and 0.21 mm. in the female. The cervical papillae are seen at a distance of 0.21 mm. and

0.23 mm. from the anterior extremity in the two sexes respectively. The oesophagus measures 0.986 mm. in the male and 1.29 mm. in the female. The junction of the oesophagus and the intestine is not well marked off.

MALE : The male measures 11.48 mm. with a maximum diameter of 0.281 mm. The single filiform testis extends into the oesophageal region, where it recurves to run for a short distance and ends in a backwardly pointed tip. The tail is devoid of caudal alae and possesses 6 pairs of papillae and a single median papilla, at the tip. Of these paired papillae three are precloacal and the rest postcloacals. The first and the second precloacals are smaller in size than the third one. Of the postcloacal the first and the second are smaller than the third. The terminal papilla is small and quite distinct. The spicules are equal but somewhat dissimilar. The right spicule has an expanded head with a slightly curved body and a pointed tip. The left has a narrow cylindrical head with a swelling at its base and a somewhat obliquely truncated posterior end. The two spicules measure 0.2 mm. in length. The tail is short being 0.11 mm. in length.

FEMALE : The female is 13.58 mm. long and 0.3 mm. wide. The vulva opens on a small conical prominence at a distance of 0.49 mm. from the head end. The muscular vagina runs posteriorly. The uteri are opisthodelphys. The anus is 0.13 mm. from the bluntly rounded tip of the tail. The uteri do not contain eggs.

Discussion : The present worm differs from the three known species of the genus in the following aspects :

The genotype *E. sergenti* Seurat, 1921, has a male, 3.3 mm. and a female, 14 mm. long. *Filaria capsulata* Annett, Dutton and Elliott, 1901, has been referred to this genus by Yorke and Maplestone, 1926 but is not fully described hence of doubtful position. The description of *E. lari* Yamaguti, 1935, is based on the females only which are 9.8-11.7 mm. long.

Singh, 1948, reported *E. asiatica* from the common house crow which is also the host of the genotype. Singh's worm differs from all the others is possessing both cephalic and caudal papillae. The present worm differs from *E. asiatica* not only in body length but also in the length and the shape of spicules 0.113-0.119 mm. and 0.114-0.124 mm. as against 0.200 mm. There is one preanal pair, one adanal pair and a terminal papilla in *E. asiatica* but three pairs of precloacal and three pairs of postcloacal and a terminal papilla in *E. buckleyi*. Moreover, the cloaca is subterminal in the former but a little in front of the tip in the latter.

In view of these differences it is regarded as a new species and named as *E. buckleyi* after Professor J. J. C. Buckley.

Host : *Captimulgus asiaticus.*

Habitat : Body cavity.

Locality : Hyderabad-Deccan (India).

Filariidae (Cobbold, 1864) Claus 1885.
DICHEILONEMATINAE Wehr, 1935.
Hamatospiculum Skrjabin, 1916.

H. alii n. sp.

A search for the parasites of birds resulted once in the recovery of a large number of males and females in the air sacs of the Himalyan Kestrel, *Cerchneis tinnunculus interstinctus* and Pallas' Fishing Eagle, *Haliaeetus leucoryphus*. Not only the air sacs were filled up with these parasites but also the body cavity lodged quite a few of them.

These are fairly stout worms, yellowish white in colour, with cylindrical bodies and slightly attenuated ends. The posterior extremity is ventrally flexed. The head bears two projecting lip-like structures surrounding the dorsoventrally elongated mouth. On either side of the oral opening, there is present an epaulette-like structure bearing altogether four pairs of submedian and one pair of lateral papillae. The teeth that are reported to be present in some species of the genus could not be traced even under the oil immersion lens. The cuticle is thin, with fine transverse striations, the striae being 10μ apart in the male and 12μ in the female. The lateral flanges are not present. The nerve ring surrounds the anterior portion of the oesophagus, a little in front of its middle region, at a distance of 0.168-0.176 mm. and 0.199-0.210 mm. from the head end, in the two respective sexes. The excretory pore opens at 0.195-0.20 mm. and 0.22-0.26 mm. from the anterior extremity in the male and the female respectively. The oesophagus is divided into a short anterior muscular and a very long glandular posterior portion. The two measure 0.26-0.30 mm. and 12.76-12.99 mm. long in the male and 0.38-0.48 mm. and 14.97-15.99 mm. in the female respectively.

MALE : The males are slightly less than half as long as the females, measuring 84-106 mm. in the length and having a maximum width of 0.59-0.65 mm. The dorsoventral diameter of the head is 0.10-0.18 mm.

The single filiform testis extends up to the oesophageal region where it makes two or three loops and ends in an anteriorly directed tip. The tail is 0.065-0.071 mm. long and possesses a pair of well-developed caudal alae, 0.240-0.255 mm. long by 0.20-0.22 mm. in maximum width. The alae are continuous round the tip of the tail. There are altogether twelve pairs of peculiarly arranged caudal papillae. Of the five pairs of precloacal papillae

the first four pairs are arranged in two groups of four each. These have long spike-like peduncles which end in knobbed tips. The fifth is sessile and is located on either side just in front of the cloacal aperture. Of the seven pairs of postcloacal papillae, three pairs are lateral, two pairs sublateral and two pairs ventral in position. The ventral papillae are small and sessile. The spicules are similar in shape but are unequal in length. The two measure 2.24-2.46 mm. and 0.49-0.55 mm., the length ratio being 4 : 1. The left or the longer spicule is thin and of uniform thickness except the posterior extremity, which is pointed and is enclosed in a delicate, transparent cuticular sheath which is continued all along the length of the spicule body. The right spicule is also of uniform diameter but it has serrations on its body and a somewhat curved tip.

FEMALE : The females are more than one and a half times as long as the males, being 159-169 mm. long and 0.69-0.78 mm. wide. The head measures 0.20-0.25 mm. in its maximum dorsoventral diameter. The tip of the anterior ovary reaches almost as far as the nerve ring. The vulva opens on a prominence situated 0.65-0.90 mm. from the anterior end. The muscular vagina runs posteriorly and the uteri are amphidelphic. The thick-shelled eggs measure 46-48μ long by 29-32μ wide. The anus is subterminal being situated at 0.056-0.082 mm. from the tip of the tail.

Discussion : Skrjabin erected the genus *Hamatospiculum* in 1916 for Schneider's worm *Filaria insignis*. Yorke and Maplestone regarded *H. brasilianum* (Stossich, 1897) Skrjabin, 1916, as the type species but Caballero, 1937, declared *H. insignis* (Scheider, 1866) Skrjabin, 1916 as the genotype and *H. brasilianum* as its synonym. Meanwhile Sandground reported *H. pertenuialatum* in 1933. Three species *H. otomelarum*, *H. dicruri* and *H. leticiae* were described by Tubangui in 1934. Johnston and Mawson added four other species, *H. howense*, *H. mcneilli*. *H. halcyonis* and *H. chibiae* in 1941. In the same year, Yamaguti reported *H. accipitris* from Japan. Caballero (1937) declared *H. quadridens* Boulenger, 1928, Sandground 1933 and Tubangui 1934 as a synonym of *H. foveatum*. The latter was described by Schneider in 1866 as *Filaria foveata* and Leidy (1886) as *Filaria megacantha* and also by Molin (1853) as *Filaria quadridens*. Wehr in 1935 redescribed Sandground's *H. nodulosum* which has been reported by various authors under several names such as *Filaria nodulosa* Rudolphi, 1819, *Filaria collurionis pulmonalis* Rudolphi, 1819, *Contortospiculum nodulosum* Yorke and Maplestone, 1926 and *Parhamatospiculum nodulosum* Skrjabin and Petrow, 1928. Schuurmans Stekhoven added the latest species *H. flagellispiculosum* from Argentina in 1952.

Wehr (1935) placed both *Hastospiculum* and *Parhamatospiculum* under the synonym of *Hamatospiculum*. Schuurmans Stekhoven (1937) redescribed *Filaria dehiscens* (Schneider) as a species of *Hamatospiculum* and seems to have agreed with Wehr. Chabaud and Choquet (1953) in their classification of Filarioidea placed *Parhamatospiculum* under the synonym of *Hamatospiculum* but retained *Hastospiculum* as a valid genus. The presence of 'epaulette-like' structures, the shape of the caudal alae, the arrangement of the papillae in general, the divided oesophagus and to a great extent the resemblance in the shape of the spicules of the parasites belonging to the two groups exhibit such similarities that the writer is strongly inclined to concur with Wehr and Stekhoven. The resemblance between the present worm and *Hastospiculum macrophallos* (Parona, 1889) Baylis, 1930, in the length of the body, the spicules and the oesophagus is so great that it exhibits a very close affinity with the parasites reported from reptilian hosts. It is advisable not to insist much on the reptilian host as a criterion for the separation of the two genera and hence they should be regarded as one and the same. The differences such as the absence of a pair of papillae on the tail of the female and the length of the body are specific rather than generic.

The parasites belonging to the genus *Hamatospiculum* may be regarded to have a wider distribution both among birds and reptiles with varied

	H. ALII		H. MACROPHALLOS	
	Male	Female	Male	Female
Length ...	84-106	159-169	80-100	250 mm.
Oesophagus ant. ...	0.30-0.36	0.52	0.35	0.55-0.60
Oesophagus post. ...	12.76-12.99	14.97-15.99	16 mm.	30 mm.
Spicules L. S. ...	2.2-2.46 mm. alate	...	L. S. 2.2-2 45 mm. R. S. 0.42-0.51 mm. (both alate)	
R. S. ...	0.493-0.555 mm. non-alate	...	...	...
Vulva ...	...	0.705-0.948	...	0.85-1.15
Caudal papillae ...	12 pairs	absent	7-8 pairs	one pair
Eggs ...	...	46-48 by 29-32μ	...	50-52 by 30-34μ

Table showing the similarities between *Hamatospiculum alii* and *Hastospiculum macrophallos*. All measurements in millimeters.

habitat. Quite a few species of *Hamatospiculum* are reported from under the skin of the head, some others from under the skin of neck. *Hastospiculum onchosercum* is recorded from the peritoneal membrane near the posterior region of intestine. The worms described by the writer are collected from the air-sacs and a few from the body cavity where they were attached to the visceral organs. Their distribution in the hosts and the habitat is so varied that it might give an impression as to the worms belonging to the different groups. Though this does not seem to be the case.

As the position of the two genera is still controversial it is thought advisable not to give the key to the species of the genus. The new species is named after Dr. S. M. Ali, Reader in Zoology, Osmania University, Hyderabad-Deccan.

Host : *Cerchneis tinnunculus interstinctus* and *Haliaeetus leucoryphus.*
Habitat : Air sacs and body cavity.
Locality : Hyderabad-Deccan (India).

Filariidae (Cobbold, 1864) Claus, 1885.
APROCTINAE Yorke and Maplestone, 1926.
Buckleyfilaria Singh, 1949.

Buckleyfilaria leiperi n. sp.

One male and a single female specimen of this parasite were collected from body cavity of *Dicrurus macrocerus.*

These are medium-sized worms having cylindrical bodies with slightly tapering extremities. The male is half as long as the female. The cuticle is smooth, transparent and devoid of striations. The head in both the sexes is truncated with rounded sides and is devoid of lips. Its dorsoventral diameter is 0.06 mm. in the male and 0.14 mm. in the female. The cephalic papillae are easily discernible and are arranged in two circles each having two pairs of submedians. There is a pair of laterally situated amphids in the outer circle. The excretory pore is seen at 0.25 mm. from the head end in the male and 0.29 mm. in the female. The nerve ring surrounds the oesophagus at 0.14 mm. and 0.15 mm. from the anterior end in the two sexes respectively.

The mouth opens into a short vestibule 32μ long in the male and 34μ in the female. It leads into a club-shaped, muscular undivided oesophagus, measuring 0.729 mm. in length in the male and 0.80 mm. in the female, occupying $^1/_{17}$th and $^1/_{32}$nd part of the total body length in the two respective sexes.

MALE : The male is 11.7 mm. long and has a maximum diameter of 0.50 mm. The tail is short broadly rounded measuring 0.26 mm. in length. It is provided with fairly developed caudal alae which are continuous round the tail and run up to 3.88 mm. anteriorly from the tip of the tail. There are altogether twelve pairs of papillae of which seven are precloacal and the rest postcloacals. The first, second and the third precloacal pairs are widely separated from the rest of the precloacals which are comparatively closer together. There are five pairs of postcloacal papillae of which the first form the cloaca and the fourth pairs are medioventrally situated, the second and the third are sublateral pairs while the fifth pair is lateral. The spicules are fairly well-developed and highly chitinized. They are subequal in length, similar in shape, measuring 0.361 mm. and 0.384 mm. respectively. The heads are somewhat expanded, while their posterior ends are spoon-shaped.

FEMALE : The female is twice as long as the male, measuring 26 mm. in length and 0.87 mm. in maximum width. The vulva is situated in the oesophageal region, opening at a distance of 0.31 mm. from the head end. The vagina has thick, muscular walls and runs posteriorly for a distance of 2.5 mm. to open into a wider common trunk of the uterus. The ovaries are located one behind the other in the anterior region. The eggs are thin-shelled measuring 33μ long by 17μ wide and contain developing embryos. The tail is 0.15 mm. long with a bluntly rounded end.

Discussion : This is the third species of *Buckleyfilaria* since 1949 when it was established by Singh. It differs both from *B. buckleyi* Singh, 1949 and *B. skrjabini* Ali, 1957 in several respects. It has the longest oesophagus of the three. The vulva is closer to the head end than in the other two. The spicules are the smallest. There are twelve pairs of caudal papillae in the present worm and eleven pairs in the genotype in which respect it comes closer to it but their disposition differs markedly in the two. In *B. buckleyi* there are five pairs of preanal, three pairs of adanal and three pairs of postanal papillae but the present worm possesses seven pairs of preanal and five pairs of postanals. There is a solitary papilla at the tip of the tail in *B. skrjabini* which is lacking in *B. leiperi.* Moreover, the present parasite possesses the longest caudal alae which run up to the posterior third of the body. Hence it is regarded as a new species and is named after Professor R. T. Leiper.

Host : *Dicrurus macrocerus.*

Habitat : Body cavity.

Locality : Hyderabad-Deccan (India).

Filariidae (Cobbold, 1864) Claus, 1885.

APROCTINAE Yorke and Maplestone, 1926.

Lissonema Linstow, 1903.

Lissonema rotundatum Linstow, 1903.

During a search for parasites in *Centropus sinensis* a large number of filarids both males and females were collected which on identification proved to be belonging to the genus *Lissonema.*

The worms are fairly stout with cylindrical bodies and slightly attenuated head and tail ends. The male is half as long as the female, measuring 25-30 mm. in length by 0.72-0.96 mm. in maximum thickness, the female being 47-59 mm. long and 0.99-1.02 mm. wide. The dorsoventral diameter of the head is 0.17 mm. and 0.19 mm. in the two sexes respectively. The cuticle is thick, devoid of transverse striations but instead, there are zigzag lines running longitudinally throughout the length of the body. The mouth is bounded by two lip-like elevations each of which bears three pairs of papillae. The papillae are sublateral in position and are situated in groups of three each. A pair of laterally situated amphids is also present. The excretory pore opens at 0.31-0.35 mm. from the anterior end in the male and 0.38-0.43 mm. in the female. The nerve ring surrounds the short, anterior muscular portion of the oesophagus at 0.23-0.25 mm. and 0.27-0.30 mm. from the head end in the two respective sexes.

The mouth opens into a very small vestibule leading into the oesophagus which is divided into a short anterior and a considerably long posterior portion, the two measure 0.28-0.32 mm. and 4.48-4.52 mm. in the male, 0.38-0.46 mm. and 5.41-6.66 mm. in the female and occupy $^1/_6$th and $^1/_8$th of the entire length of the body in the two sexes respectively.

MALE : The males have a broad head and a rounded tail end. The cloacal aperture is 0.15-0.19 mm. from the tip of the tail which is devoid of alae. There are four pairs of prominent caudal papillae of which one pair is preanal, one adanal and two pairs of postanals. In addition to these there is a single papilla at the tip of the tail. The spicules are similar in shape and subequal in length, being 0.20-0.21 mm. and 0.22-0.25 mm. long. Their heads are expanded and the tips orbicular.

FEMALE : The females are twice as long as the males. The vulva opens on a prominence guarded by lips at 0.75-0.80 mm. from the head end. The muscular vagina measures 2.16-2.43 mm. in length and is posteriorly directed where it is joined by the two uteri. The eggs are oval 55-59μ long by 26-29μ wide. The tail is very short and rounded. The rectum is not atrophied but opens into the anus which is at 0.1 mm. from the tip of the tail.

Discussion : The genus *Lissonema* was established by Linstow in 1903. Railliet and Henry synonymised it with *Aprocta*, but Boulenger revived it in 1928. Sandground (1933) added two more species *L. laevicutis* and *L. striata* to the genus. Since then no other species has been recorded. The present worm is being reported from *Centropus sinensis*, the host of the genotype. The length of the body, number of papillae and several other measurements are identical with Boulenger's description of *L. rotundatum*.

Boulenger's diagnosis of the genus will have to be modified under present observations. He has reported one median preanal, 3 or 4 pairs of postanal papillae but in the present worm there is one pair of preanal, one pair almost adanal and two pairs postanal and one single median papilla at the tip of the tail. Thus the generic characteristics are to be regarded as follows :

Aproctinae : Thick worms, mouth bordered by two small lip-like elevations, head with 6 pairs of papillae found in four groups of three each, oesophagus divided into a short narrow, anterior region and a long, broad posterior portion, anal opening distinct, male with one pair of preanals, one pair of adanals and two pairs of postanals and a single median papilla at the tip of the tail ; parasites of the body cavity of birds.

Genotype : *L. rotundatum* Linstow, 1903.

Host : *Centropus sinensis.*

The type specimens of the species described in this part are deposited in Zoology Department, Osmania University.

SUMMARY

1. *Singhfilaria pavonica* n. gen., n. sp. is described from *Pavo cristatus* and is compared with the related genera of Onchocercinae.
2. *Chandlerella thapari* n. sp. is reported from *Saxicola torquata*. *Vagrifilaria* is synonymised with *Chandlerella* and the type species of the former, *C.* (*V.*) *columbigallinae* (Augustine, 1937) n. comb., is recorded from a new host.
3. *Paraprocta brevicnuda* Maplestone, 1931, is reported from a new host, *Upupa epops orientalis.*
4. *Eufilaria buckleyi* n. sp. is described from the Night Jar *Caprimulgus asiaticus.*
5. *Hamatospiculum alii* n. sp., is recorded from *Cerchneis tinnunculus interstinctus* and *Haliaeetus leucoryphus* ; *Hastospiculum* is synonymised with *Hamatospiculum.*
6. A new species of *Buckleyfilaria* is described from *Dicrurus macrocercus.*
7. *Lissonema rotundatum* Linstow, 1903, is reported.

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Finally, I must acknowledge the invaluable help rendered by the Indian National Scientific Documentation Centre (INSDOC) for kindly providing microfilms of the foreign publications.

SYSTEMATIC LIST OF THE NEMATODE PARASITES OF BIRDS DESCRIBED IN THIS WORK

PART I

Family ACUARIIDAE Seurat, 1913

Subfamily ACUARIINAE Railliet, Henry and Sisoff, 1912

I. *ACUARIA* Bremser, 1811
1. *A. anthuris* (Rud., 1819) Railliet, Henry and Sisoff, 1912
2. *A. brevispicula* Maplestone, 1932
3. *A. alii* n.sp.
4. *A. upupa* n.sp.
5. *A. singhi* n.sp.
6. *A. dicrura* n.sp.
7. *A. crami* n.sp.

II. *Dispharynx* Railliet, Henry and Sisoff, 1912
8 *D. nasuta* (Rud., 1819) Stiles and Hassall, 1920
9. *D. pavonis* Sanwal, 1951
10. *D. skrjabini* n.sp.
11. *D. indicus* n.sp.

III. *Rusguniella* Seurat, 1919
12. *R. alii* n.sp.

Family ANCYRACANTHIDAE Railliet, 1916

Subfamily SCHISTOROPHINAE Travassos, 1918

IV. *Torquatella* Yorke and Maplestone, 1926
13. *T. singhi* n.sp.

PART II

Family THELAZIIDAE Railliet, 1916

V. *Oxyspirura* Drasche in Stossich, 1897

14. *O.* (*O.*) *peipingensis* Hsu, 1933
15. *O.* (*O.*) *singhi* n.sp.
16. *O.* (*O.*) *hyderabadensis* n.sp.
17. *O.* (*O.*) *otocompsa* n.sp.
18. *O.* (*O.*) *gubernaculata* n.sp.

Family TETRAMERIIDAE Travassos, 1914

Subfamily TETRAMERINAE Railliet, 1915

VI. *Tetrameres* Creplin, 1846

Subgenus *Tetrameres* Creplin, 1846

19. *Tetrameres* (*Tetrameres*) *monospicules* n.sp.

Subgenus *Gynaecophila* Sobolev, 1950

20. *Tetrameres* (*Gynaecophila*) *ardeae* Shigin, 1953
21. *T.* (*G.*) *minutes* n.sp.
22. *T.* (*G.*) *singhi* n.sp.

Subgenus *Petrowimeres*

23. *Tetrameres* (*Petrowimeres*) *cordoniferens* n.sp.

VII. *Microtetrameres* Travassos, 1915

Subgenus *Microtetrameres* Travassos, 1915

24. *Microtetrameres* (*M.*) *travassosi* n.sp.
25. *Microtetrameres* (*M.*) *orioles* n.sp.

Subgenus *Gubernacules* n. sub. gen.

26. *Microtetrameres* (*Gubernacules*) *egretes* n.sp.
27. *M.* (*Gubernacules*) *mirzai* n.sp.
28. *M.* (*G.*) *Osmaniae* n.sp.

Subfamily GEOPETITINAE Chabaud, 1951

VIII. *GEOPETITIA* Chabaud, 1951

29. *Geopetitia chabaudi* n.sp.

PART III

Family DIPETALONEMATIDAE Wehr, 1935

Subfamily ONCHOCERCINAE Leiper, 1911

IX. *Singhfilaria* n.g.

30. *Singhfilaria pavonica* n.g. n.sp.

Subfamily SPLENDIDOFILARINAE Chabaud and Choquet, 1953

X. *Chandlerella* Yorke and Maplestone, 1926

31. *Chandlerella thapari* n.sp.

32. *C. columbigallinae* Augustine, 1937

XI. *Paraprocta* Maplestone, 1931

33. *Paraprocta brevicauda* (Chandler, 1924) Maplestone, 1931

XII. *EUFILARIA* Seurat, 1921

34. *Eufilaria buckleyi* n.sp.

Family FILARIIDAE (Cobbold, 1864) Claus, 1885

Subfamily DICHEILONEMATINAE Wehr, 1935

XIII. *Hamatospiculum* Skrjabin, 1916

35. *Hamatospiculum alii* n.sp.

Subfamily APROCTINAE Yorke and Maplestone, 1926

XIV. *Buckleyfilaria* Singh, 1949

36. *Buckleyfilaria leiperi* n.sp.

XV. *Lissonema* Linstow, 1903

37. *Lissonema rotundatum* Linstow, 1903

CLASSIFIED LIST OF HOSTS (BIRDS) WITH NEMATODE PARASITES DESCRIBED FROM THEM

Orders:

I. PASSERIFORMES

Dicrurus caerulescens (not in W. Pakistan)	*Acuaria dicrura*
Dicrurus macrocercus	*Torquatella singhi*
	Oxyspirura (oxyspirura) hyderabadensis
	Buckleyfilaria leipri
Sturnia malabarica (not in W. Pakistan)	*Acuaria anthuris*
Temenuchus pagodarum	*Acuaria singhi*
Acridotheres tristis	*Acuaria brevispicula*
Acridotheres ginginianus	*Acuaria alii*
Oriolus oriolus	*Microtetrameres (M.) orioles*
Gracula religiosa (not in W. Pakistan)	*Microtetrameres (M.) travassosi*
Motacilla cinerea caspica	*Oxyspirura (O.) gubernaculata*
Anthus richardi rufulus	*Oxyspirura (O.) singhi*
Saxicola torquata indica	*Chandlerella thapari*
Saxicola caprata	*Acuaria crami*
Argya caudata	*Oxyspirura (O.) peipingensis*
Turdoides terricolor	*Dispharynx pavonis*
	Geopetitia chabaudi
Copsycus saularis	*Geopetitia chabaudi*
Otocompsa jocosa fusicaudata (not in W. Pakistan)	*Oxyspirura (O.) otocompsa*

II. COCCOYGIFORMES

Centropus sinensis parroti	*Lissonema rotundatum*

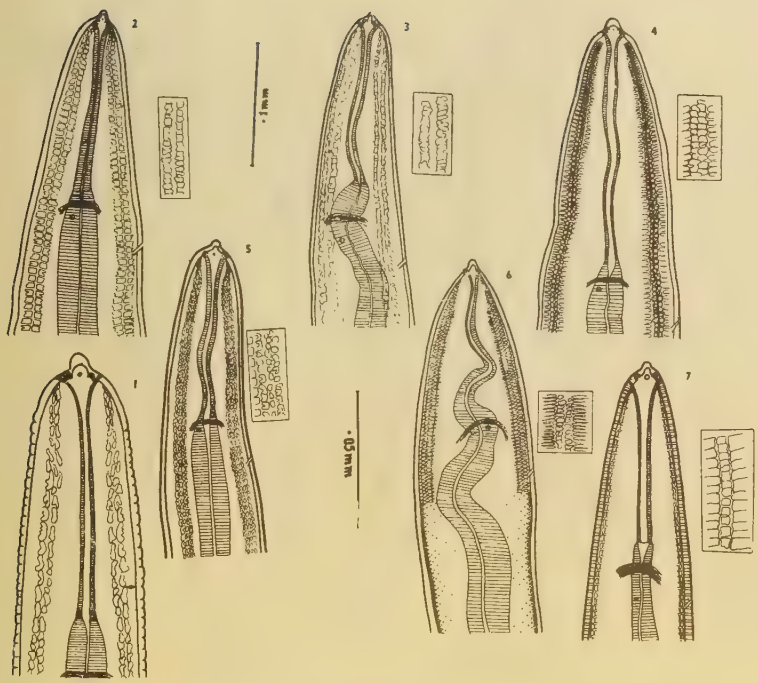
III. CORACIIFORMES

Caprimulgus asiaticus	*Eufilaria buckleyi*
Upupa epops orientalis	*Acuaria upupa*
	Paraprocta brevicauda
Ceryle radis leucomelanura	*Rusguniella alii*

IV. STRIGIFORMES

Tyto alba	*Dispharynx indicus*
Anthene brama indica (*carine brama*)	*Dispharynx nasuta*

V.	ACCIPITRIFORMES	
	Accipiter nisus nisosimilis	*Microtetrameres* (*G.*) *osmaniai*
	Haliaetus leucoryphus	*Dispharynx skrjabini*
		Hamatospiculum alii
	Cerchneis tinnunculus interstinctus	*Hamatospiculum alii*
	(*Falco tinnunculus*)	*M.* (*G.*) *mirzai*
VI.	ANSERIFORMES	
	Dendrocygna javanica	*Tetrameres* (*P.*) *cordoniferens*
VII.	ARDEIFORMES	
	Ardea cinerea	*Tetrameres* (*G.*) *ardea*
	Ardeola grayii	*Tetrameres* (*G.*) *minutes*
	Egretta grazetta	*Microtetrameres* (*G.*) *egretes*
	Ciconia ciconia	*Tetrameres* (*G.*) *signhi*
VIII.	RALLIFORMES	
	Porphyrio poliocephalus	*Tetrameres* (*T.*) *monospicules*
IX.	COLUMBIFORMES	
	Crocopus phaenicopterus	*Chandlerella* (*Vagrifilaria*)
X.	(not in W. Pakistan)	*columbigallinae*
	GALLIFORMES	
	Pavo cristatus	*Singhfilaria pavonica*
	(not in W. Pakistan)	

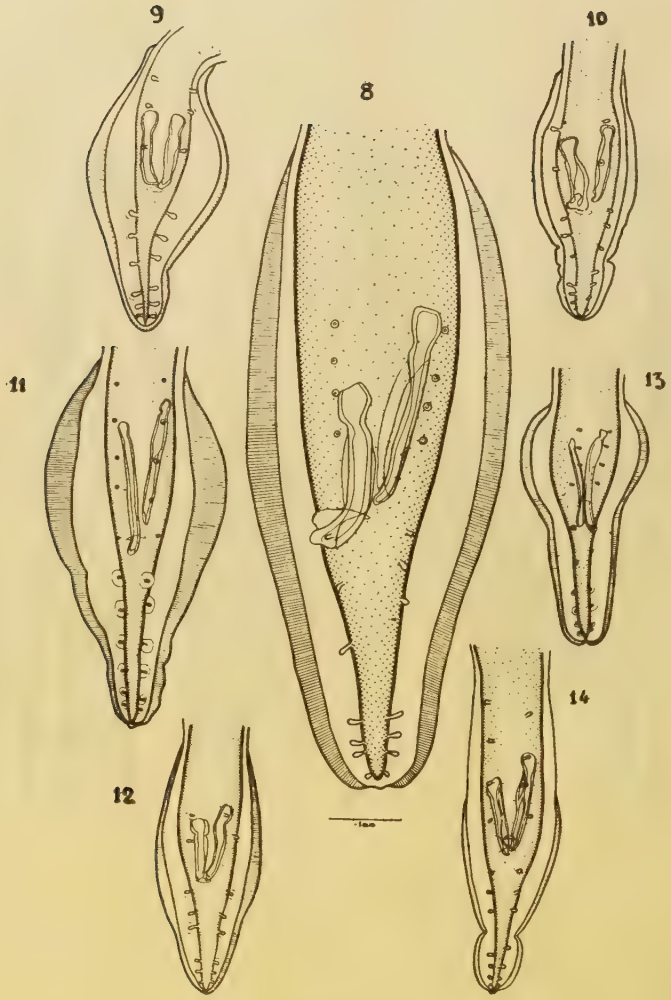


Acuaria

Anterior ends, males, lateral views and cordons.

Figs: 1. *A. anthuris*. 2. *A. brevispicula*. 3. *A. alii*. 4. *A. upupa*. 5. *A. singhi*. 6. *A. dicrura*. 7. *A. crami*.

Scale: 0.1 mm. applies to the anterior ends.
0.05 mm. applies to the cordons.

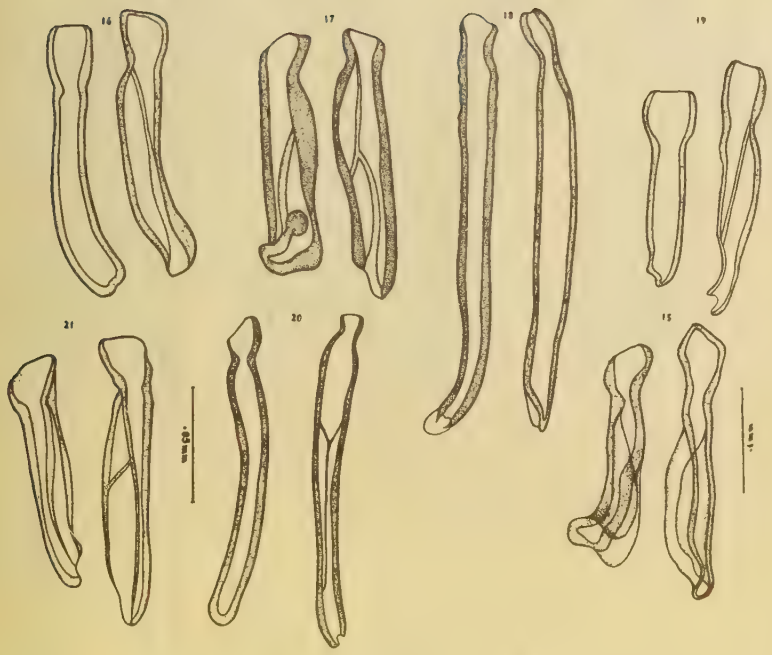


Acuaria

Posterior ends, males, Ventral views.

Figs: 8. *A. anthuris*. 9. *A. brevispicula*. 10. *A. alii*. 11. *A. upupa*. 12. *A. singhi*. 13. *A. dicrura*. 14. *A. crami*.

(All figures drawn to the same scale).

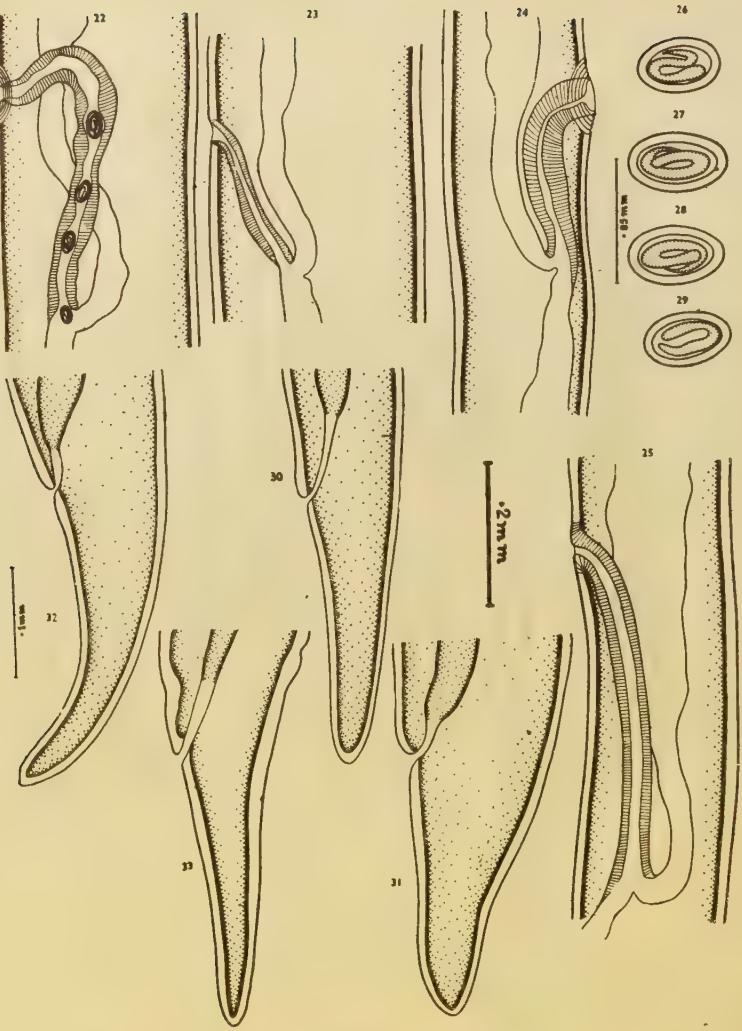


Acuaria

Spicules, Ventral views

Figs: 15. *A. anthuris.* 16. *A. brevispicula.* 17. *A. alii.* 18. *A. upupa.* 19. *A. singhi,* 20. *A. dicrura.* 21. *A. crami.*

Scale: 0.1 mm. applies to fig. 15.
0.05 mm. applies to figs. 16, 17, 18, 19, 20 and 21.



Acuaria

Bodies of females showing vulva, vagina and uterus

Figs: 22. *A. brevispicula.* 23. *A. alii.* 24. *A. upupa.* 25. *A. dicrura.*

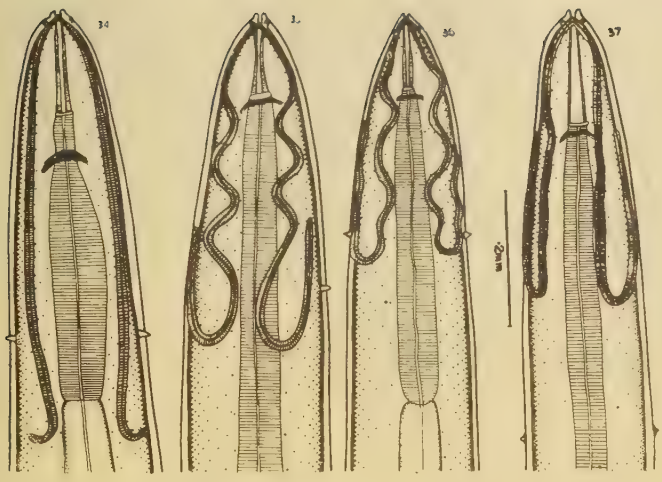
Eggs

Figs: 26. *A. brevispicula.* 27. *A. alii.* 28. *A. upupa.* 29. *A. dicrura.*

Posterior ends, females, lateral views.

Figs: 30. *A. brevispicula.* 31. *A. alii.* 32. *A. upupa.* 33. *A. dicrura.*

Scale: 0.1 mm. applies to figs. 30, 31, 32, and 33.
0.05 applies to figs. 26, 27, 28 and 29.
0.2 mm. applies to figs. 22, 23, 24 and 25.



Dispharynx

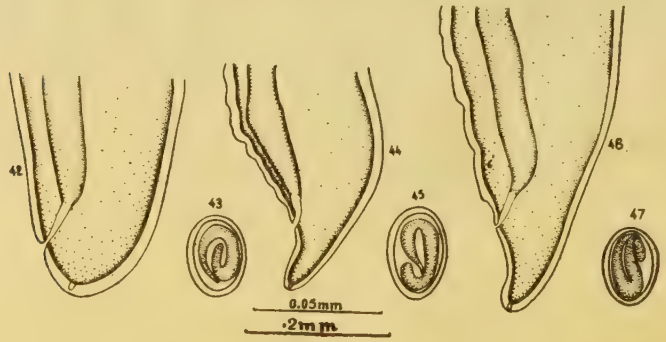
Anterior ends, males, ventral views

Figs: 34. *D. skrjabini.* 35. *D. nasuta.* 36. *D. pavonis.* 37. *D. indicus.*
(All figures drawn to the same scale).

Dispharynx

Posterior ends, males, ventral views.

Fig: 38. *D. skrjabini*. 39. *D. nasuta*. 40. *D. pavonis*. 41. *D. indicus*.
(All figures drawn to the same scale).



Dispharynx

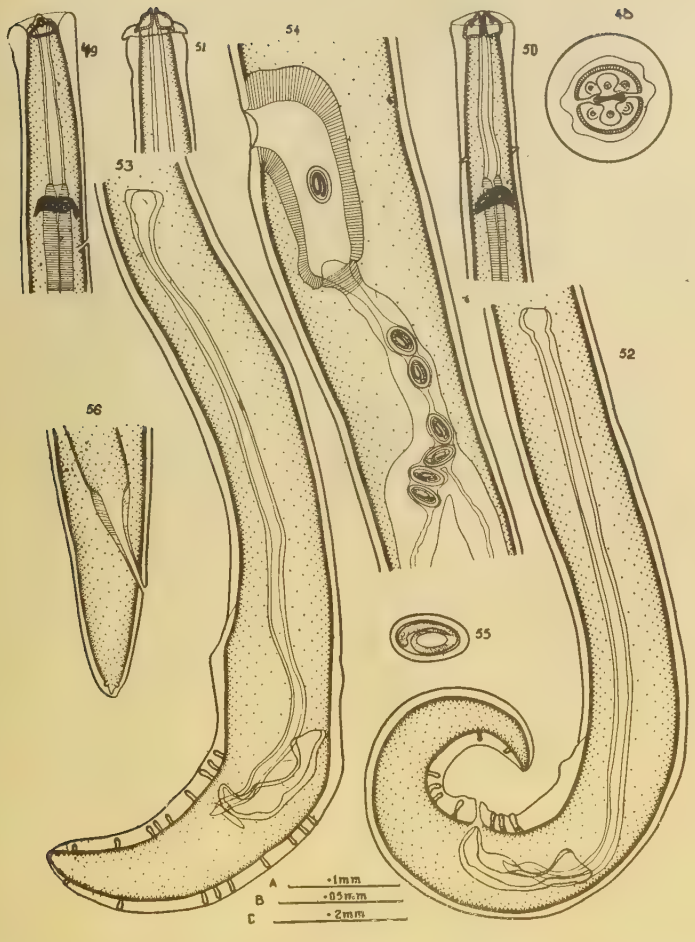
Females, posterior ends, lateral views.

Figs: 42. *D. skrjabini*. 44. *D. nasuta*. 46. *D. pavonis*.

Eggs.

43. *D. skrjabini*. 45. *D. nasuta*. 47. *D. pavonis*.

Scale: 0.2 mm. applies to Figs. 42, 44, and 46.
0.05 mm. applies to Figs. 43, 45 and 47.



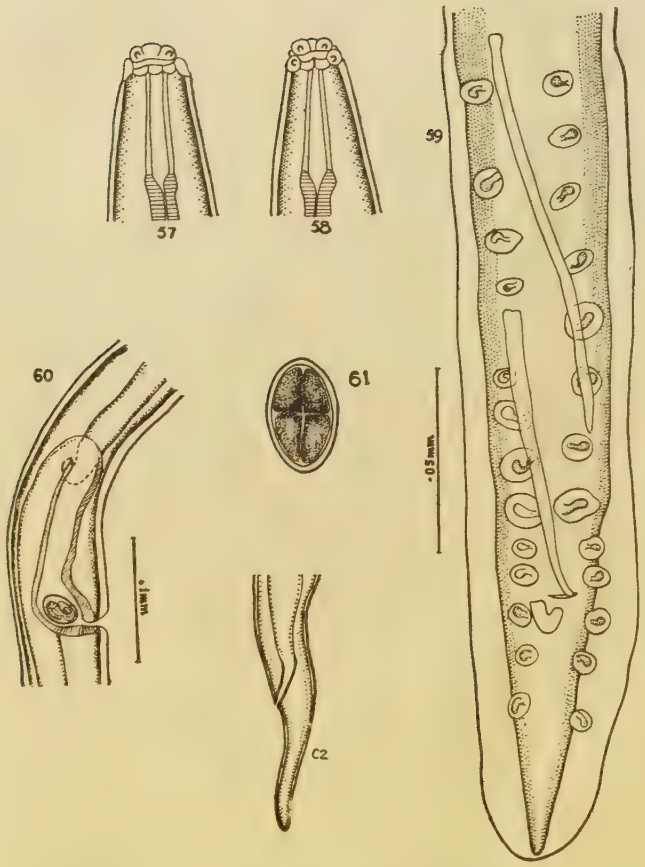
Rusguniella alii n.sp.

Figs: 48. End-on view, head, 49. Anterior end, male, lateral view. 50. Anterior end, male, ventral view, 51. Anterior end female ventral view with reverted cephalic lappets. 52. Posterior end, male, lateral view. 53. Posterior end, male, ventral view, 54. Female, uterus and vagina with eggs, 55. Egg, 56. Female tail end.

Scale: A applies to Figs. 49, 50, 51 and 56.

B applies to Figs. 48, 55 (48 magnified).

C applies to Figs. 52, 53 and 54.



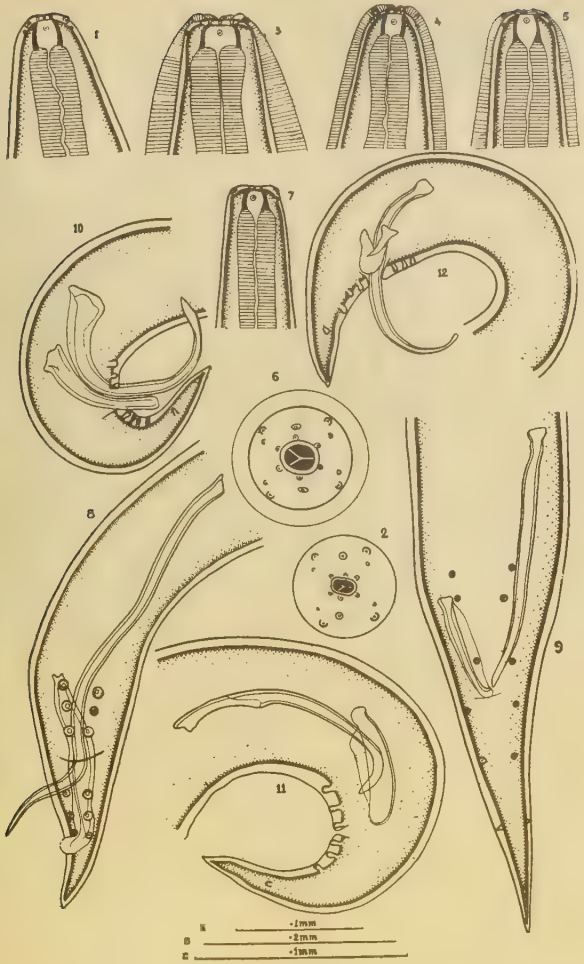
Torquatella singhi n.sp.

Figs: 57. Anterior end, lateral view. 58. Anterior end, ventral view. 59. Posterior end, male, ventral view.

60. Female body showing vulva, vagina and uteri. 61. Egg. 62. Female, posterior end.

Scale: 0.05 mm. applies to figs. 57, 58, 59 and 61.

0.1 mm. applies to figs. 60 and 62.



Oxyspirura

Anterior ends, males, lateral views

Figs: 1. *O.* (*O.*) *peipingensis*. 3. *O.* (*O.*) *singhi*. 4. *O.* (*O.*) *hyderabadensis*. 5. *O.* (*O.*) *otocompsa*. 7. *O.* (*O.*) *gubernaculata*.

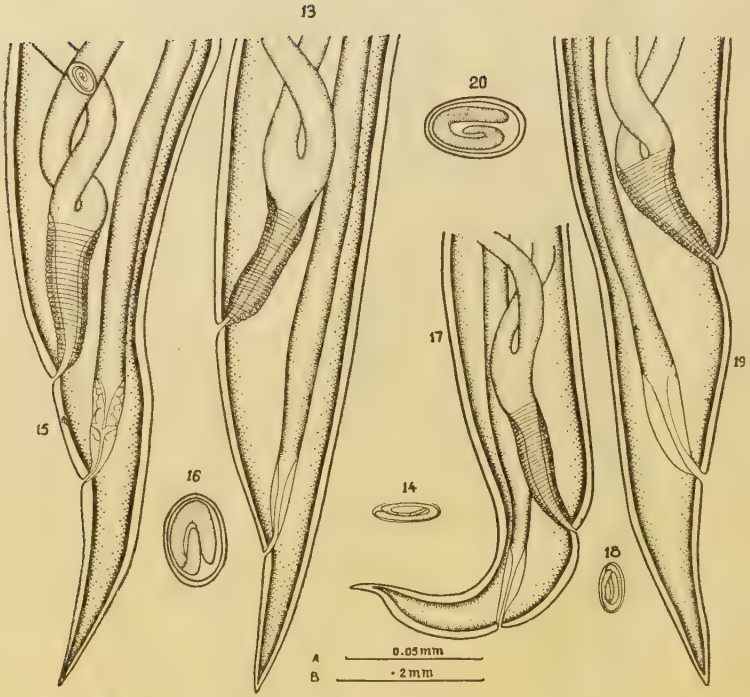
Ends-on views

Figs: 2. *O.* (*O.*) *peipingensis*. 6. *O.* (*O.*) *otocompsa*.

Posterior ends, males, ventral views

Figs: 8. *O.* (*O.*) *peipingensis*. 9. *O.* (*O.*) *singhi*. 10. *O.* (*O.*) *hyderabadensis*. 11. *O.* (*O.*) *otocompsa*. 12. *O.* (*O.*) *gubernaculata*.

Scale: A applies to the anterior ends.
B applies to male tail ends.
C applies to end-on views, heads.



Oxyspirura

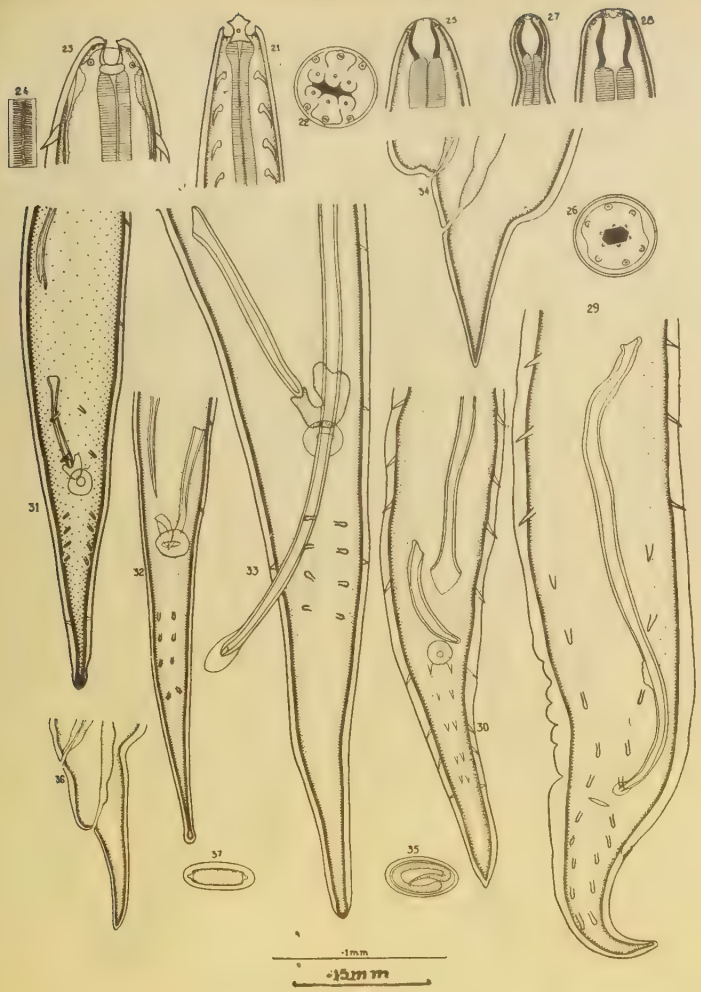
Posterior ends of females, lateral views

Figs: 13. *O.* (*O.*) *peipingensis*. 15. *O.* (*O.*) *singhi*. 17. (*O.* (*O.*) *hyderabadensis*. 19. *O.* (*O.*) *otocompsa*.

Eggs

Figs: 14. *O.* (*O.*) *peipingensis*. 16. *O.* (*O.*) *singhi* n.sp.
18. *O.* (*O.*) *hyderabadensis*. 20. *O.* (*O.*) *otocompsa*.

Scale: A applies to the eggs.
B applies to the posterior ends of females.



Tetrameres

Anterior ends, males, lateral views

Figs: 21. *T.* (*T.*) *monospicules*. 23. *T.* (*Petrowimeres*) *cordoniferens*. 25. *T.* (*Gynaecophila*) *ardeae*. 27. *T.* (*G.*) *minutes*. 28. *T.* (*G.*) *singhi*.

End-on views

Figs: 22. *T.* (*T.*) *monospicules*. 26. *T.* (*G.*) *ardeae*.
24. Magnified cordons of *T.* (*T.*) *cordoniferens*.

Posterior ends, males, ventral views.

Figs: 29. *T.* (*T.*) *monospicules*. 30. *T.* (*P.*) *cordoniferens*. 31. *T.* (*G.*) *ardeae*. 32. *T.* (*G.*) *minutes*. 33. *T.* (*G.*) *singhi*.

Posterior ends, females, lateral viewes and eggs

Figs: 34. *T.* (*T.*) *monospicules*. 36. *T.* (*G.*) *ardeae*.
35. *T.* (*T.*) *monospicules*. 37. *T.* (*G.*) *ardeae*.

Scale: 0.15 mm. applies to figs. 34 and 36. 0.1 mm. applies to all the rest.

Microtetrameres

Anterior ends, males, lateral views

Figs: 38. *M.* (*M.*) *travassosi*. 39. *M.* (*M.*) *orioles*. 41. *M.* (*Gubernacules*) *egretes*. 42. *M.* (*G.*) *osmaniae*. 43. *M.* (*G.*) *mirzai*.

Fig: 40. End-on view of *M.* (*M.*) *orioles* (Magnified).

Posterior ends, males, ventral views

Figs: 44. *M.* (*M.*) *travassosi*. 45. *M.* (*M.*) *orioles*. 46. *M.* (*G.*) *egretes*. 47. *M.* (*G.*) *osmaniae*. 48. *M.* (*G.*) *mirzai*.

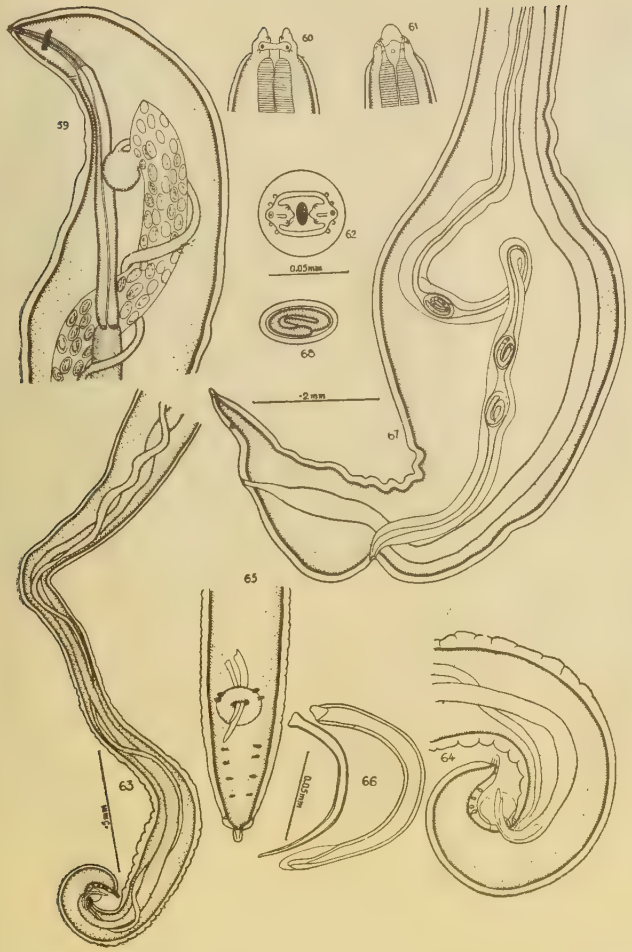
Posterior ends, females, lateral views

Figs: 49. *M.* (*M.*) *travassosi*. 51. *M.* (*M.*) *orioles*. 53. *M.* (*G.*) *egretes*. 55. *M.* (*G.*) *mirzai*. 57. *M.* (*G.*) *osmaniae*.

Eggs

Figs: 50. *M.* (*M.*) *travassosi*. 52. *M.* (*M.*) *orioles*. 54. *M.* (*M.*) *egretes*. 56. *M.* (*G.*) *mirzai*. 58. *M.* (*G.*) *osmaniae*.

Scale: A applies to Figs. 38-48, 50, 52, 54, 56 and 58. B applies to Figs. 49, 51, 53, 55 and 57.



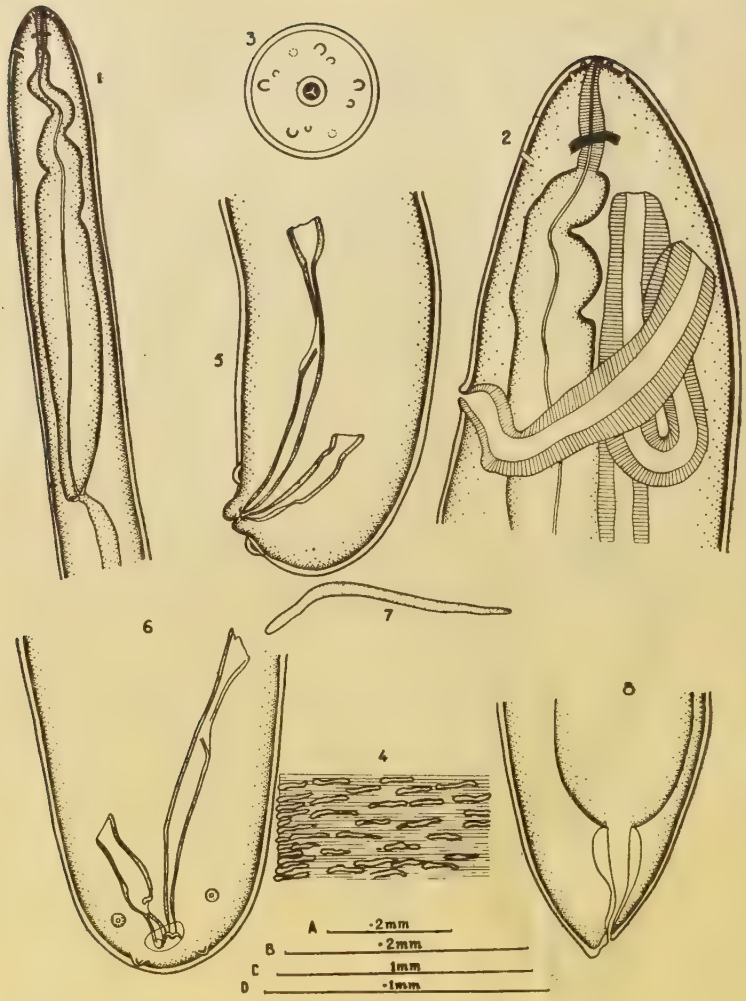
Geopetitia chabaudi n.sp.

Figs: 59. Females, anterior end, lateral view. 60. Male, head end, ventral view. 61. Male, head end lateral view. 62. End-on view, head. 63. Male, posterior end showing the peduncle lateral view. 64. Male, posterior end lateral view. 65. Male, posterior end, ventral view. 66. Spicules. 67. Female posterior end showing the vulva and anus. 68. Egg.

Scale: 0.05 mm. (above) applies to figs. 60, 61, 62 and 68.

0.2 mm. applies to figs. 64, 65 and 67.

0.5 mm. applies to figs. 59 and 63.



Singhfilaria pavonica n.gen. n.sp.

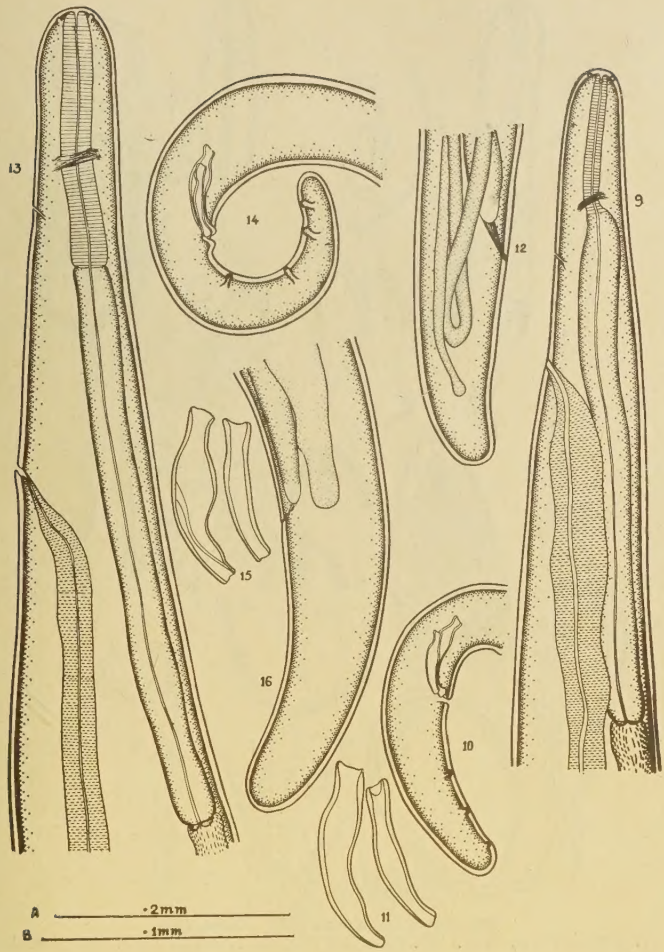
Figs: 1. Anterior end, male. 2. Anterior end, female. 3. End-on view, head. 4. Cuticle with fine striations and fusiform thickenings. 5. Posterior end, male, lateral view. 6. Posterior end, male, ventral view. 7. Microfilaria. 8. Female tail end.

Scale: A applies to fig. 2.

B applies to figs. 5, 6 and 8.

C applies to fig. 1.

D applies to figs. 3, 4 and 7.



Chandlerella thapari n.sp.

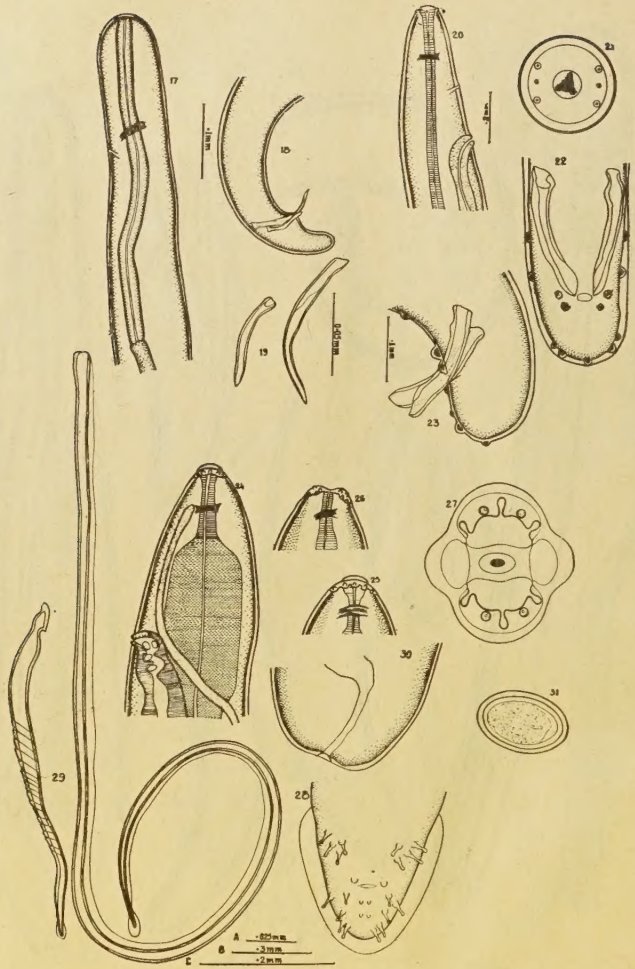
Figs: 9. Female anterior end and position of vulva. 10. Posterior end, male, lateral view. 11. Spicules. 12. Female, posterior end.

Chandlerella columbigallinae (Augustine 1937) n. comb.

Figs: 13. Female anterior end. 14. Posterior end, male, lateral view. 15. Spicules lateral view. 16. Female posterior end.

Scale: A applies to figs. 9, 10, 12, 13, 14 and 16.

B applies to figs. 11 and 15.



Paraprocta brevicauda Maplestone, 1931

Figs: 17. Anterior end, male. 18. Posterior end, male, lateral view. 19. Spicules, lateral view.

Scale: 0.1 mm. applies to figs. 17 and 18.
0.05 mm. applies to fig. 19.

Eufilaria buckleyi n.sp.

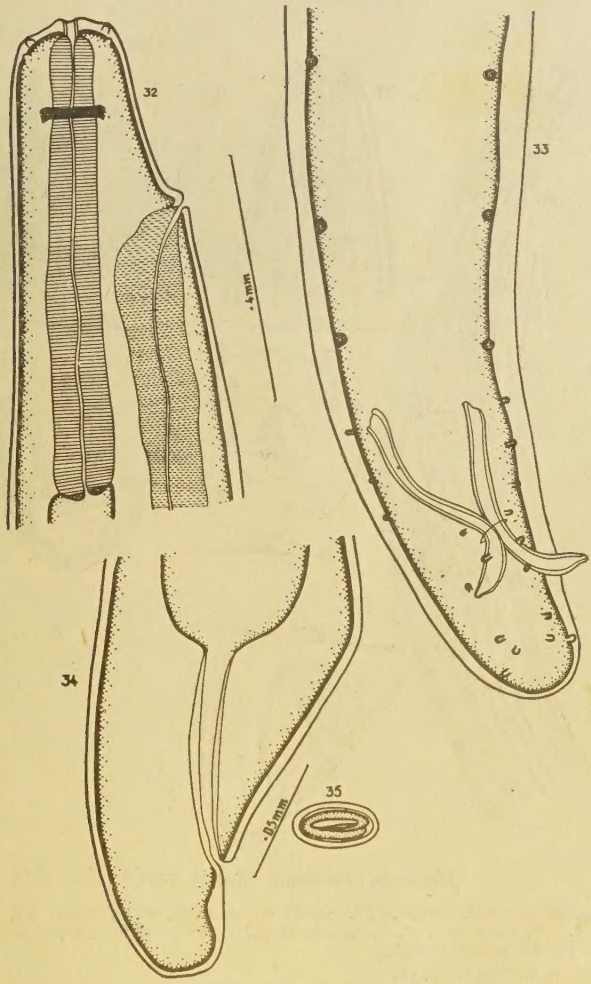
Figs: 20. Anterior end, female, lateral view. 21. End-on view, head. 22. Posterior end, male, ventral view. 23. Posterior end, male, lateral view.

Scale: 0.2 mm. applies to fig. 20.
0.1 mm. applies to figs. 22 and 23.

Hamatospiculum alii n.sp.

Figs: 24. Anterior end, female, lateral view. 25. Anterior end, male, lateral view. 26. Anterior end, male, ventral view. 27. End-on view, head. 28. Posterior end, male, ventral view, 29. Spicules. 30. Posterior extremity, female lateral view. 31. Egg.

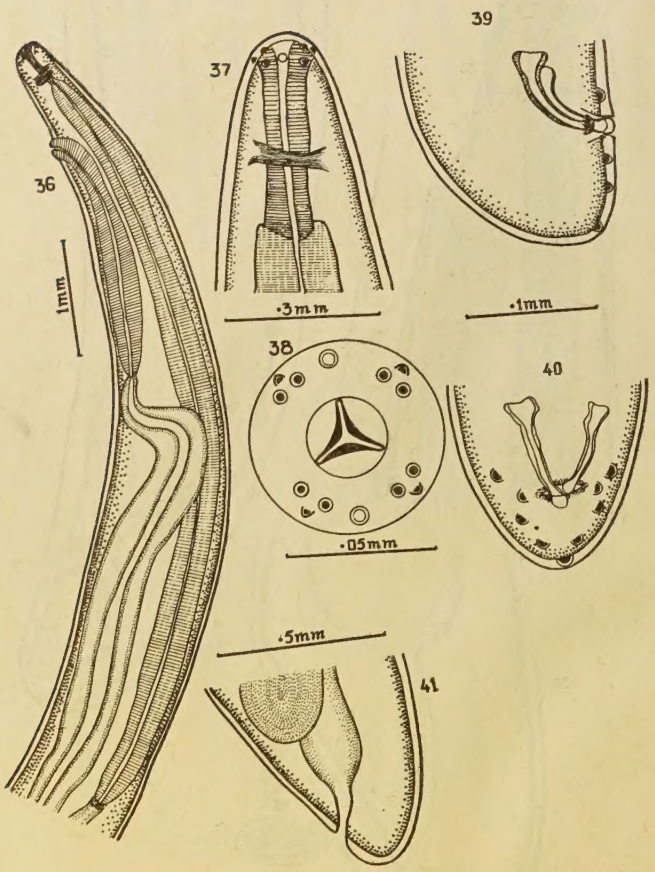
Scale: A applies to fig. 31. B applies to figs. 24, 25, 26 and 30.
C applies to figs. 27, 28 and 29.



Buckleyfilaria leiperi n.sp.

Figs: 32. Anterior end, female. 33. Posterior end, male, ventral view. 34. Posterior end female. 35. Egg.

Scale: 0.4 mm. applies to figs. 32, 33 and 34.
0.05 mm. applies to fig. 35.



Lissonema rotundatum Linstow, 1903

Figs. 36. Anterior end, female. 37. Anterior end, male, lateral view. 38. End-on view, head. 39. Posterior end, male, lateral view. 40 Posterior end, male, ventral view. 41. Female posterior end.

Scale: 1.0 mm. applies to fig. 36.

0.3 mm. applies to fig. 37.

0.05 mm. applies to fig. 38.

0.5 mm. applies to fig. 41.

0.1 mm. applies to figs. 39 and 40.